The Builder.

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Entrance Tower, the Chapel, All Saints' Convent, St. Albans.—Mr. Leonard Stokes, F.R.I.B.A., Architect ..... *Double-Page Photo Litho.*
Château Mauricien, Wimereux.—Mr. John Belcher, A.R.A., F.R.I.B.A., Architect ..... *Double-Page Ink Photo.*
The Grange, Totteridge.—Mr. C. A. Nicholson, Architect ..... *Single-Page Ink Photo.*
Design for Refitting Mission Church, Walworth.—Mr. C. A. Nicholson, Architect ..... *Single-Page Ink Photo.*
Competitive Design, Central Library, Hull.—Mr. J. F. Duthoit, A.R.I.B.A., Architect ..... *Single-Page Photo Litho.*
Competitive Design for Cardiff Law Courts.—By Messrs. W. A. Pite and R. S. Balfour ..... *Single-Page Photo Litho.*

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Notes on the Swedish Timber Trade.

II.

THE Swedish export trade in logs and square timber is comparatively small. At many of the mills—even the largest — no more square timber is sawn than is required in the structures appertaining to the mills, such as quays, jetties, gangways, &c. The annual exports of logs and square timber amount to only about 100,000 standards, less than one-tenth of the output of deals, battens, and boards. The fact is, of course, that the British market is now supplied with square timber chiefly from the United States and Canada. Most European coniferous trees are too small for conversion into beams of even moderate scantling.

The first fact which strikes the visitor to the Swedish timber yards is the small size of the converted stuff. Stack after stack of small battens and deals follow each other for hundreds of yards; here and there are stacks of 9 in. by 3 in. deals, but at many of the ports one looks in vain for anything larger. The scantling most frequently seen is 7 in. by 2 in., but immense quantities of smaller stuff are stacked, the width varying by half inches down to as little as 3 in. The most common thickness is 2 in., but stuff 2½ in., 3 in., and 4 in. thick is also cut, and in one yard we noticed some battens measuring 5½ in. by 2½ in. In addition to these small battens there are large quantities of boards from 4 in. by ⅞ in. to 9 in. by 1¼ in., the wide boards being chiefly for the Dutch market. Many sizes of deals are also cut, so that almost any size can be obtained from stock, either at one port or another. Among the larger scantlings we noticed were 8 in. by 2 in. and 3 in., 9 in. by 2 in. and 3 in. and 4 in., 10 in. by 3 in. and 4 in., 11 in. by 2 in. and 3 in. and 4 in., and 12 in. by 3 in. and 4 in., and other sizes can no doubt be obtained. This variety is a great advantage to the architect and builder, as nearly any specification can be carried out without waste of material.

The large scantlings cannot, however, be obtained at all the ports, at any rate, in great quantities. At some of the mills practically nothing larger than 7 in. by 3 in. is cut; perhaps there may be a small output of 9 in. by 2 in. and 9 in. by 3 in. stuff, but in comparison with the trade in battens the quantity of deals is quite insignificant. English measures are generally used both for length and cross sections.

A glance at the logs collected within the booms adjoining the mills suffices to explain the smallness of the scantlings which are obtained. At many of the ports the logs are nearly all less than 9 in. in diameter at the smaller end, and consequently cannot be converted into anything wider than about 7 in. These logs are often converted into six pieces by means of vertical saw-frames containing five saws, as shown in fig. 1. The pieces C and D are 2 in. thick, and are at once converted into a rectangular section, as shown by the dotted lines, by passing them through a pair of parallel circular saws set at the required distance apart. These may be afterwards sawn into two 1-in. boards, either by a circular saw or by a band re-saw, the latter being preferred, as the saw is thinner and consequently wastes less material. The pieces B and E form two boards 1 in. thick, and the slabs A and F may, if large enough, be utilised for thin narrow boards or small moulds, or otherwise sent to the charcoal yard and there converted into charcoal. Larger logs are often treated in a different manner, involving less labour and less waste. The log is first slabbed on two sides (at one operation), as shown in fig. 2, No. 1. It is then turned on to one of the slabbed sides, and passed through another saw-frame, by which it is converted into three or more deals and boards and two additional slabs (fig. 2, No. 2). From each of the four slabs a board can generally be obtained, but it will probably contain a good deal of sap. It will be observed that by this method the three deals are completed at two operations, whereas by the former method *each* deal must, after passing the saw-frame, be run through the parallel circular saws. Of course there are many other methods of conversion, different mills adopting different methods. The log shown in fig. 2 might be cut to yield a central piece 11 in. by 3 in. instead of 9 in. by 3 in., but this would involve more labour.

The converted deals are carried automatically along tables and gangways by means of revolving rollers (driven by power) placed at suitable intervals, and are discharged into tramway trucks, in which they are conveyed to the timber-yard. Here they are stacked according to size, being laid with open joints to facilitate the circulation of air, and being covered on the top with a sloping roof of loose boards to protect them from the burning heat of the summer sun.

The Stora Kopparbergs Company at Skutskär, near Gefle, in addition to this natural seasoning, has a large drying kiln—the first of its kind, we believe, in Sweden. It is a lofty structure with brick walls, and consists of two parallel rows of cells with upper and lower air-conduits between. There are sixteen cells in all, each capable of holding about twenty standards, and each has movable wood covers at the top. The kiln measures about 250 ft. by 75 ft., and raised above the top of it is a roof which is carried forward over a long and lofty store-shed beyond. Steam is brought in a wooden conduit raised on trestles, from a special boiler placed alongside the nine other boilers in the saw-mills, and is passed through pipes between which a circulation of air is maintained by means of fans. The hot air passes along the upper of the two conduits which run between the rows of cells, and is admitted to the cells through shutters which can be regulated as required. The wood in the cells is stacked with open joints, part being laid on tiers of iron brackets projecting from the walls. After passing through the cell the air returns along the lower conduit. One row of cells is at

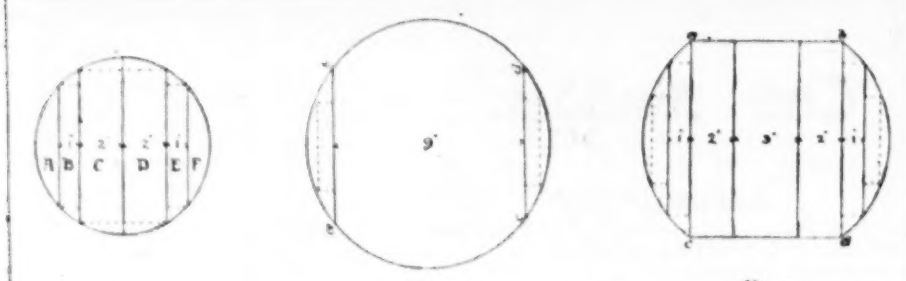


Fig. 1. *Fig. 2.*

work, while the other is being emptied and refilled. Two electric cranes, travelling, respectively, over the two rows of cells, are used for raising the wet wood, carrying it as required and lowering it into the cells, and also for lifting the dried wood from the cells and conveying it into the store-shed beyond. In from two to four days, according to the size of the scantling and other factors, the wood is dry enough for shipment.

The Korsnäs Company, also at Gefle, is following the Stora Kopparbergs Company's lead, and other companies will, no doubt, soon do the same. The great wonder is that such kilns have not been built years ago, as they give better results than months of natural seasoning, besides effecting a great saving of storage space and of time; logs can be converted into a cargo of deals, and these can be dried and shipped without undue detention of the vessel.

The deals and battens are not generally cross-cut—*i.e.*, the ends are not sawn off—until a vessel is waiting for them. The deals are run in trucks to one of the many sheds built for the purpose—we are describing now the method in operation at the Stora Kopparbergs Works—and each deal is seized by two men, one at each end, who lay it on a table marked with feet and mètres, and with pencils indicate where the defective ends must be cut off. A lever is pressed, and revolving rollers rise through the table and carry the deal forward to a boy, who, by pressing another lever, raises a circular saw which cuts off the end of the deal at the first mark. The operation is repeated at the second mark, and the deal travels forward to the barge or lighter which is moored at the end of the shed. There two boys are at work, stencilling the brand on the ends of the deals. These are then ready for conveyance to the vessel which is moored to an adjacent quay. Electric motors supply the power in these sheds. The ends cut from the deals are piled by women into stacks, according to their size and quality, part being used for firewood and part for conversion into boards for boxes or other small articles.

There is no waste in a Swedish sawmill. At some of the mills, as at Sundsvall, much of the "offal" is cut into 3-ft. lengths and sold as firewood to the small coasting steamers. The best is shipped to England (being sold by the cubic fathom, *i.e.*, 6 ft. by 6 ft. by 6 ft.), to be there sawn and split into firewood for domestic purposes. The chips, shavings, and sawdust are used as fuel for the boilers of the works, being conveyed to these automatically by "paternoster" belts running in wooden troughs in the lower story of the mill. Other offal, such as the small convex slabs sawn from the logs, is converted into charcoal, a small part of which is used for the blacksmith's forges in the sawmills, the greater part, however, being sold for smelting the well-known Swedish iron.

The usual method of charcoal-burning consists in building a circular pile of wood (the pieces being placed vertically) about 18 yards in diameter and 12 ft. high. Boards are fixed horizontally around this, forming a series of shelves so that the exterior can be covered with charcoal dust or saw-dust to exclude the air. The fire is lit at the centre of the top, and the whole of the top is covered with saw-dust. The burning continues for five or six weeks before it is complete and the charcoal ready for raking out. A brick charcoal-kiln at the Stora Kopparbergs Works does the work equally well in about six days, and has the advantage of separating the tar and wood-spirit so that these can be drawn off by pipes.

The commonest defect of Swedish deals, battens, and boards, is sap, a defect which is unavoidable so long as small logs are converted into the largest possible scantlings, and boards are cut from slabs. The best boards, of course, are cut from the central parts of the logs, either directly or, more generally, by re-sawing battens, but other boards are obtained from the outer portions of the log, as shown in figs. 1 and 2, and these are certain to be more or less sappy. The deals and battens also in many cases trench so closely upon the periphery of the log that they include a considerable proportion of sapwood. Indeed, a great many logs are converted into larger scantlings than they are properly capable of making, the result being that the deals and battens are wany for a considerable proportion of their length. The presence of sap not only discolours the wood and renders it unfit for varnishing, but makes it more liable to decay. There can be no doubt that this is a most serious defect in Swedish wood generally, but especially in wood from ports where comparatively small scantlings only can be obtained. Where the logs are of larger size, as at Gefle and some of the most northerly ports, deals are often obtained practically free from sap. Thus the central deal in fig. 2, No. 2, will be of this kind, and the two side deals will contain only a small amount of sap at the angles nearest the periphery of the log.

It is only natural that the owners of the saw-mills try to get the largest possible scantlings out of a log, as much better prices can be obtained for larger stuff. Thus, in December last, a Petersburg standard (*i.e.*, 165 cubic feet) of 7 in. by 2½ in. Gefle red ("Mixed" quality) was worth 12*l.*, but the same quantity of 9 in. by 3 in. stuff was worth no less than 16*l.*, an increase of 33 per cent. in value, due solely to the extra size of scantling, the quality and the number of cubic feet being the same in both cases. In this connexion it may be interesting to give the prices for the other qualities of red wood per standard, and to compare them with the prices current a year before. These figures are extracted from the British Consul's last report on the trade of Gefle:—

Scantling.	Quality.	Price per Standard. Dec., 1898.	Dec., 1899.
		£ s.	£ s.
9 in. by 3 in.	Mixed.	13 0	16 0
,,	Thirds.	11 0	14 0
,,	Fourths	8 10	11 0
,,	Fifths.	7 10	10 0
7 in. by 2½ in.	Mixed.	10 10	13 0
,,	Thirds.	8 10	10 0
,,	Fourths.	7 10	8 15
,,	Fifths.	6 15	8 0

The prices for 1899 show an increase over those for 1898 of about 27 per cent. for 9 in. by 3 in., and about 16 per cent. for 7 in. by 2½ in. These figures prove the increasing scarcity of large scantlings. Indeed, a builder recently informed us that, in reply to his inquiry for 11 in. by 4 in. stuff, an English timber merchant declared that he had none either in stock or on the way. The time does not appear to be far distant when English architects will be compelled to specify that all joists and roof-timbers larger than, say, 7 in. by 3 in. must be of pitch-pine or other American wood.

Swedish boards are sold in the rough as they leave the saws, or planed and thicknessed; in the latter case, they are sometimes also tongued and grooved. Beaded boards are also made as well as moulds for door-panels, moulded architraves, and other joiners' woodwork. Into the details of manufacture of these goods we need not enter. Suffice it to say that the requirements of different countries appear to be carefully studied. Holland prefers floor-boards about 9 in. wide, while for Great Britain boards 6 in. or 7 in. wide are made. Holland also prefers a bead with deeper quirks than are desired in this country.

The trees are generally felled during the winter, from December to March or April, and the logs are run down to the frozen rivers and lakes; when the snow and ice melt the logs float down to convenient places near the mouths of the rivers, where they are sorted according to their different owners, and the sorted logs are then passed on to the different mills. At Sundsvall, for example, the logs are sorted at the mouths of the Indals and Ljungan rivers, and then formed into rafts and towed by steam-tugs to the thirty-nine saw-mills scattered about the harbour. The Stora Kopparbergs Company's logs are, however, sorted at Farnäs on the Dal River, and floated thence to the saw-mills along a private canal about six miles long, constructed at a cost of nearly 30,000*l.*; alongside this canal a circular wooden conduit about 4 ft. in diameter conveys fresh water to the wood-pulp mill belonging to the company.

In conclusion the qualities and brands now adopted by a few of the Swedish saw-mills will be given, partly to show the various classifications adopted and partly in order that architects may have some guide to the quality of wood supplied to their buildings. The brands are arranged according to the different districts, beginning at the north and proceeding southwards and finally up the west coast to Gothenburg. The double classification adopted in the

Skelleftea district is worth notice. The different meanings of the term "Unsorted," or "U/S," ought also to be considered. Sometimes the term is accurately applied, and includes wood of all qualities. This is generally the case with white wood. Occasionally, also, it has this meaning when applied to red wood, but very much more frequently "Unsorted" red wood includes only "Thirds" and lower qualities, and *not* "Firsts" and "Seconds" (or "Mixed").

—		Sawn.
Piteå, Storfors and Bergvik,	1sts and 2nds..	STOR
	3rds and 4ths..	FORS
	Unsorted..	STF
	6ths..	★★★★
Skelleftea, Öhrviken,	Mixed red..	⛪OB⛪
,,	3rds ,, ..	O★B
,,	4ths ,, ..	◆O◆
,,	5ths ,, ..	OWB
,,	6ths ,, ..	OHAB
,,	1sts ,, ..	O⛪F
,,	(Mixed and 3rds)	
,,	2nds red	O★F
,,	(4ths and 5ths)	
,,	u/s red..	OBF
,,	u/s white..	OBG
Skelleftea, Ursviken,	Mixed red..	SA⛪B
,,	3rds ,, ..	S—A—B
,,	4ths ,, ..	S=B
,,	5ths ,, ..	—S—
,,	6ths ,, ..	✣
,,	1sts ,, ..	SK⛪AB
,,	2nds ,, ..	SK★AB
,,	u/s ,, ..	SAB
,,	u/s white..	SAB
Skelleftea Hals/grund,	u/s red and white ..	H★B
Skelleftea, (Markstedt & Son)	Mixed..	AM&S
,,	3rds..	A+M
,,	4ths..	MA
,,	5ths..	MS
,,	u/s ..	AMS
,,	Inferior 5ths..	MST
Umeå, Hörnefors,	Mixed..	NO⛪RD
,,	3rds..	NO★RD
,,	4ths..	NORD
,,	5ths..	NO+RD
,,	u/s..	HR
,, Mo,	Mixed..	JCK
,,	3rds..	C+K
,,	4ths..	K+K
,,	5ths..	KKK
,,	6ths..	VVV
,,	Wrack..	VVVV
,,	u/s..	M+D
Ornsköldsvik, Husum,	Mixed and 3rds..	HUSUM
,,	4ths..	HUS
,,	5ths..	GIDA
,,	6ths..	H★H
Ornsköldsvik, Domsjö (as Mo, Umeå).....		

—	Sawn Red and White.	Planed. Red.	Planed. White.
Hernösand, Kramfors, 1sts..	..	KR⛪FS	..
,, 2nds..	..	KR★FS	..
,, Mixed..	L⛪O	KR⛪FS	KR⛪FS
,, Boards .	KRAMFORS	..	..
,, 3rds..	LO	KFORS	KFORS
,, 4ths..	W★W	..	..
,, 5ths..	W	..	..
,, u/s..	K⛪S	K⛪S	K⛪S
Hernösand, Marieberg, 1sts..	BERGERE	+ + +	
,, 2nds..	BERGER	++	
,, 3rds..	ELB	+	
,, 4ths..	K×M	(Unmarked)	
,, 5ths .	D⛪B	..	
,, u/s..	B⛪R	B⛪R	
Hernösand, Bollsta, 1sts..	BOLLSTA, or BST	..	
,, 2nds..	H+G	..	
,, 3rds..	B+B	..	
,, 4ths..	B+B+B	..	
,, 5ths..	B+B+B+B	..	
,, u/s..	GVAB	..	
for battens Mixed and 3rds	BOLLSTA⛪	..	
for battens 4ths and 5ths	BOLLSTA	..	

—	Sawn.	Planed.
Sundsvall, Svartvik, 1sts..	..	SV⛪VIK
,, 2nds..		SV★VIK
,, Mixed..	S⛪V	..
,, 3rds..	SDD	SDD
,, 4ths..	D★S	..
,, 5ths..	S⛪K	..
,, 6ths..	K◆W	..
,, u/s..	SWK	SWK
Sundsvall, Fagervik, Mixed..	F⛪W	FTA
,, 1sts..	..	F⛪W
,, 2nds..	..	F★W
,, 3rds..	F★W	F—W
,, 4ths..	F⛪W	F IV W

—		Sawn.	Planed.
Sundsvall, Fagervik,	5ths..	F—W	..
,,	6ths..	FSW	..
,,	u/s..	FAW	FAW
Sundsvall, Strand,	Mixed	AXEL	..
,,	3rds..	AXL	..
,,	4ths..	AXE	..
,,	5ths..	AXX	..
,,	6ths..	—XX—	..
,,	u/s ..	RAND	..
Sundsvall, Carlsvik,	Mixed..	H⛪B	..
,,	3rds..	H÷B	..
,,	4ths..	H—B	..
,,	5ths..	H=B	..
,,	6ths..	H★★B	..
,,	u/s..	HUB	..
Sundsvall, Hofvia,	Mixed..	HO⛪ID	..
Sundsvall (G. P. Braathen)	3rds..	GPB	..
,,	4ths..	H★D	..
,,	5ths..	HWO	..
,,	6ths..	BWH	..
,,	u/s..	B★H	..
Hudiksvall, Hudiksvall	1sts..	..	⛪HTA⛪
,,	2nds..	..	HT⛪AB
,,	Mixed..	H⛪H	..
,,	3rds..	H★H	HTAB
,,	4ths..	HHH	..
,,	5ths..	⛪HB	..
,,	6ths..	MDM	..
,,	u/s..	+HH+	HWALL
Hudiksvall, Enånger	1sts..	..	⛪PAT⛪
,,	2nds..	..	⛪P+P⛪
,,	Mixed..	PAT	..
,,	3rds	PP	⛪A+A⛪
,,	4ths..	AA	..
,,	5ths..	TT	..
,,	6ths..	PPP	..
,,	u/s..	AIB	..
Söderhamn, Ljusne-Woxna			
,,	Mixed..	W⛪K	..
,,	3rds	WK	..
,,	4ths..	K	..
,,	5ths..	K★K	..
,,	6ths..	KWK	..
,,	u/s..	★W★	..
Söderhamn, Bergvik Co	Mixed..	BSSC	..
(Sandarne, Nyhamn, & Djupvik)	3rds	BC	..
	4ths..	BBB	..
	5ths..	◆◆◆	..
,,	Interior 5ths..	◆◆◆	..
,,	Inferior redwood..	B ◆ ◆ B	..
,,	u/s..	B—Co.	..
Söderhamn, Längrör	Mixed	O⛪W	..
,,	3rds..	IWL	..
,,	4ths..	EWL	..
,,	5ths..	AWL	..
,,	6ths..	WMW	..
,,	u/s..	OWL	..

Quality.	Sawn.	Planed. Redwood	Planed. Whitewood.
Gefle, Korsnäs, Extra 1sts..	..	⛪ KAB	..
,, 1sts..	KAB	K⛪B	..
,, 2nds..	NAS	⛪ NAS	
,, 3rds..	★★★	★★★	
,, 4ths..	★★	..	
,, Unsorted..	K⛪B	..	K⛪B
Gefle, Stora Kopparbergs, Extra 1sts..	..	⛪SKB⛪	
,, 1sts..	..	SKB	SKB
,, 2nds..		DOM	DOM
,, Mixed..	SKB	..	
,, 3rds..	DOM	DM	DM
,, 4ths..	DM	..	
,, 5ths..	D★M	..	
,, u/s red..	XXX	..	
,, u/s white..	BBB	..	⛪Skutskur⛪
,, Discoloured..	..	F⛪B	..
Gefle, Holmsund, 1sts..	..	HS⛪ND	
,, 2nds..		HS★ND	
,, Mixed..	H⛪D		
,, 3rds..	HDD	HLND	
,, 4ths..	HND	..	
,, 5ths..	HFD	..	
,, 6ths..	HMS	..	
,, Inferior 6ths..	HSUS		
,, u/s..	HSUND	HSUND	

—	Sawn.	Planed.
Gothenburg, Tingstad, 1sts	..	T⛪S
,, 2nds..	..	TAS
,, Mixed..	T⛪S	
,, 3rds..	TAS	SAT
,, 4ths..	SAT	..
,, 5ths..	SFT	..
		red. white.
,, Säfvenäs, 1sts..	..	S⛪F ..
,, 2nds..	..	SAF ..
,, Mixed..	S⛪F	.. S⛪F
,, 3rds..	SAF	FAS FAS
,, 4ths..	FAS	.. ..
,, 5ths..	OD	.. ..
,, u/s red..	SABS	.. ..
,, u/s white .	S⛪F	.. ..
,, Strömman 1sts..	..	S⛪L
,, & Larsson, 2nds..	..	SAL
,, Mixed..	S⛪L	..
,, 3rds..	SAL	SOL
,, 4ths..	SOL	..
,, 5ths..	+S+	..
,, U/S..	SFL	SFL

—	Red.	White
Stockholm, L. W. Lundborg, Mixed..	L⛪W	..
,, 3rds..	LWL	..
,, 4ths..	LL	..
,, 5ths..	L	..
,, u/s..	WLL	WL
Norrköping, M. Ljungqvist, Mixed..	M⛪L	..
,, 3rds..	M+L	..
,, 4ths..	M★L	..
,, 5ths..	M—L	..
,, u/s..	MLT	..
Westervik, L. W. Lundborg, Mixed..	LWF	..
,, 3rds..	LEF	..
,, 4ths..	LSF	..
,, 5ths..	LTF	..
,, u/s..	LLF	LFL

NOTES.

The Ordnance Survey.

THE recently-issued Report of the Ordnance Survey shows that the Department has been very busy in providing maps for the troops in South Africa. The 1-in. map of England being complete, the bulk of the current work, we presume, is disposed of, though re-surveys are, of course, always being requisitioned. One fact recorded in the Report is a little interesting to those familiar with foreign Government maps. It is that "a selection of Ordnance Survey maps has been sent to form part of the British exhibit at the Paris Exhibition." There was a time when the productions of our Survey were looked up to by interested persons on the Continent; but it is not too much to say that the maps of most Continental countries are now far better than the British maps. The French, German, and Russian official maps of similar scales are more detailed, and they are clearer. The method of classifying roads and their cartographic representation, are far ahead of anything we have produced in England—so foreigners will not be much enlightened by this display at the Paris Exhibition on the part of the Ordnance Survey Department.

No. 187, Fleet-street, and St. Dunstan's-in-the-West.

BUILDING operations have been begun for an enlargement, on the east side, of the offices of the Law Life Assurance Society, No. 187, Fleet-street, which were designed by John Shaw the younger. The new buildings are being erected by Messrs. Howard & Co., after plans and designs prepared by Mr. W. E. Clifton. They occupy the forecourt, on the west side, of the tower of the church of St. Dunstan's-in-the-West (1831-2) designed by John Shaw the elder. The Consistory Court of London issued in August of last year a faculty for building over the forecourt flush up to the tower, Dr. Tristram, Q.C., Chancellor of the Diocese, stating that "the Court is of opinion that it would not be justified in . . . refusing to sanction an alteration which the Court holds will not be detrimental to the interior part of the church." The trustees under the Act 10 Geo. IV., c. 96, for rebuilding the church, have sold the open space to the Society for 4,500*l.* It was stated in Court that the purchase moneys are to be devoted to the building of a rectory house on the east side of the tower, so that the body of the church as now seen from the street will be blocked in, and the architectural effect of the tower rising from the ground will be quite destroyed.

The Haberdashers' Company's Schools.

THE Board of Education have signified their approval of a scheme drawn by the Charity Commissioners for the administration of

Aske's Charity, of which the income, derived from house property in Hoxton and 1,500 acres in Kent, amounts to 16,500*l.* per annum. The scheme establishes a governing body of nineteen persons, of whom three shall be women, comprising representatives of the School Board for London, the County Councils of London and Middlesex, the Senate of the University of London, and the Court of Common Council. Of the existing four schools, there are two at Hatcham, one at Hampstead, and one—in temporary premises—at Acton. For a new school at Acton, of which Mr. Henry Stock was appointed architect last year, a sum of 60,000*l.* is set apart out of the endowment fund, and preference will be given to the children and grandchildren of freemen of the Company; a yearly sum of 1,500*l.* is also to be devoted in benefit of poor freemen. Mr. Henry Stock is architect also of the new Aske's School to be erected at West Hampstead. The buildings of the former school at Hoxton now belong to the London Technical Education Board and are being adapted for purposes of a Polytechnic for East London. They were erected in 1825-6, after D. R. Roper's plans and designs, on the site of the Aske's Hospital, built in 1691 from the designs of Robert Hooke, the celebrated mathematician, and remarkable for its classical piazza or colonnade with an ambulatory 340 ft. long, which fronted all of the ground floor between the two wings. The north wing, known as "Haberdasher's House," remained until 1887, when the Company leased the site for artisans' dwellings. It was a conspicuous building of red brick, square on plan, three stories high, with a mansard roof and high angle-pedimented dormers in the attic floor, being very similar to Edial Hall, Lichfield, where Dr. Johnson kept his school. By his will (1688) Robert Aske bequeathed a sum of 20,000*l.* in trust to the Company to be laid out by them in buying ground within one mile from London for an almshouse for twenty poor freemen, and other land to yield each pensioner 20*l.* a year. He directed that the remainder of the money should be invested in land on behalf of as many boys as the income derived therefrom would support, at the rate of 20*l.* each for his schooling and maintenance. A model in wood of Hooke's building is preserved at Haberdashers' Hall.

Prismatic Lighting.

DURING the last few years the principle involved in the Fresnel lens has been applied with considerable success for aiding the transmission of light to dark interior spaces in buildings. Prismatic lights of various kinds have proved to be so useful that they are regarded by architects and builders as indispensable adjuncts to certain types of buildings in large cities. It is, therefore, interesting to notice that the subject is now receiving attention at the hands of the Franklin Institute. A brief review of the art of prismatic lighting is contained in a paper recently read before the Institute by Dr. W. H. Greene. Omitting from consideration pavement lights, for which only one form, the right-angled prism, is admissible, the author proceeds to discuss the two general classes into which prismatic window-lights may be divided. One group comprises those in which the glass has prisms, or lens segments, of any desired angle on the front surface, whilst the back of the sheet is plain. In the other group are included devices consisting of sheets having a series of prisms or lenses on both sides. In considering the relative merits of parallel and divergent light transmission, it should be remembered that the former system, sometimes aimed at by makers, cannot be so effective as the latter. By transmitting light into a room in parallel lines inconvenience must be experienced from shadows projected from opaque objects in the path of the entering light, and there will be little or no reflection from the walls and floor. On the other hand, by the method of divergent transmission, even more light is thrown into the room, and, moreover, its distribution is more advantageous, because repeated reflections effect the practical obliteration of shadows, and the uniform diffusion of light to all parts of the interior. Attention is very properly directed to the necessity for correct disposition of the angles or curves of prismatic or lenticular surfaces as the case may be. Inaccurate angles or curves may seriously diminish efficiency by the dispersion or loss of light, resulting from reflections in the interior of the glass. Dr. Greene describes several types of lighting glass coming within the two general divisions previously mentioned, and he especially commends one form having prisms on the interior surface, and lenticular panels on the exterior surface but arranged transversely to the direction of the prisms. This form of construction possesses admirable powers of diffusion both in horizontal and vertical planes, and when two windows are employed for one apartment the overlapping and reflected rays of light tend to prevent the occurrence of shadows such as are generally produced by other methods of prismatic lighting. The paper was freely discussed, and the subject generally has been referred to the Committee on Sciences and Arts for further investigation.

Fire Insurance Rules.

THE increasing use of electricity for power purposes, and the higher pressures at which it is now being delivered at the consumers' terminals, has induced several fire insurance companies to issue supplements to their rules for electrical installations. The new supplementary rules of the Royal Insurance Company will prove interesting reading to electrical engineers and to the users of electricity for power purposes. They deal with the special safeguards to be observed when installing electrical power plant in textile mills and other special risks. Electrical contractors, before installing a power plant, would do well to provide themselves with a copy of these rules, as otherwise troublesome, and sometimes expensive, alterations may have to be made after the completion of the installation, or extra rates will be charged. The supplementary rules of the Royal Insurance Company for special risks seem to us to be very reasonable, and although their adoption may lead to a slightly greater initial expense, yet the consumer will subsequently get the benefit in having less to pay for maintenance and repairs, apart altogether from the fire risk. For example, in cold stores and ice factories ordinary insulating materials for the wires would soon break down, owing to the clammy dampness associated with low temperatures, and hence armoured or lead-sheathed conductors should be used throughout. We were not surprised to notice that special precautions have to be taken for the electrical heaters for the glue and paste kettles used in bookbinding works. In addition to the sheet metal protection for the surface of the table the heaters should stand on feet, so as to be at least 3 in. above the table, and must have wire guards round them to prevent papers or books from touching them. When a motor is supplied at 500 volts the company very properly advise that a magnetic cut-out should be used, as with this pressure it is very difficult effectually to break the circuit with an ordinary fuse. The question of whether the case of the motor should be earthed or not is left to the consideration of the Board of Trade. In towns where there are electric tramways which work on the overhead system special precautions have to be taken in houses supplied with telephones, call bells, &c., to prevent fires caused by an overhead wire breaking and coming into contact with the trolley wire, and thus conveying a current to the house which might burn up the electrical instrument fixed in it and thus cause a fire. The minimum protection recommended is a fusible cut-out.

The Manchester Sewage Scheme.

AT last the Manchester Corporation has decided upon a scheme for the treatment of the sewage of the city. It is not too much to say that unless great pressure had been brought to bear by the Local Government Board and the Mersey and Irwell Joint Committee the Fabian methods of the Corporation would have been pursued still further. Early in July the Corporation was prosecuted by the Joint Committee on account of the foul effluents from the sewage works, and the stipendiary magistrate, tired of imposing nominal fines, granted penalties of 50*l.* a day for the five days respecting which evidence was tendered, and added, significantly, "If nothing is decided in September, we shall have no option but to impose penalties, if asked to do so, *de die in diem*." The Corporation knew that the Joint Committee "meant business," and as a fine of 18,000*l.* per annum was no trifle, even for a city like Manchester, the Corporation has taken the magistrate's threat to heart, and has "decided in September" what scheme it will adopt. After the report of the three experts, to which reference has already been made in these columns, it was practically certain that bacterial purification would be selected, but the details of the scheme recommended by the experts did not commend themselves to the Local Government Board. The area of the filter-beds was considered too small by 50 per cent., and a greater area of land was also demanded. Some bellicose members of the Corporation wished to resist these demands, but wiser counsels prevailed, and eventually the scheme of bacterial purification, as amended by the Local Government Board, was adopted, although eighteen members still recorded their votes in favour of the culvert scheme. The first cost of the adopted scheme is estimated at 487,283*l.*, or about 120,000*l.* more than the experts' scheme. The Rivers Committee gave some figures as to the comparative cost of working the proposed system of purification and the existing precipitation process, but these figures are far from convincing. Sir Bosdin

Leech, in presenting these estimates, said that a saving of 7,000*l.* per annum would be effected by doing away with chemical precipitation, equal to a capitalised sum of 200,000*l.*, and added that the first cost of the new scheme was therefore "practically reduced by 200,000*l.* if they deducted the saving in chemicals and sludge." But a little later in his speech, after stating that the annual cost of maintenance of the adopted scheme would be "under 20,000*l.*," he declared that this is "roughly the amount now spent at Davyhulme for maintenance, including precipitation." Where, then, is the saving of 7,000*l.* per annum? Again, the amount of sludge which will be retained in the open septic tanks is an unknown quantity, but the experiments at Leeds show that it will be very considerable, unless it is allowed to pass on to the filters, in which case the capacity of the filters will be rapidly reduced.

London Telephone System.

THE Post Office system of telephones in London, which will probably start working in a few months, marks a new era in the history of telephony in this country. The network will extend from Reigate northward to Waltham Abbey, and from Romford westward to Harrow, embracing an area of 640 square miles. At the present time many of the streets in the City and elsewhere are opened up, and hundreds of workmen are employed making trenches for the telephone cables. The central exchange will be in the Savings Bank building, Queen Victoria-street, and there will be exchanges at Westminster, Kensington, Wimbledon, Putney, Richmond, Chiswick, Kingston, and Twickenham, which will be opened at the same time. The switchboards for the central exchange will be sufficient for 10,000 subscribers, and the sub-stations will have capacities varying between 600 and 2,000, but provision will always be made for subsequent additions. The materials employed are all of the most substantial description; the wires are sheathed with lead, and are insulated with paper so as to make the capacity between the twin conductors a minimum, and hence the sounds transmitted will be as clear and distinct as possible. The ducts to be used for the wires are made of glazed earthenware, and there are sometimes as many as fifty of them in one trench. The manholes which will be used for jointing and testing are made of several sizes, but the arrangements are all uniform throughout. The system of working employed will be that known as the "central battery system," and the batteries will be kept in the City and the inner sub-exchanges. In this method the mere act of lifting the receiver from the hook lights a lamp at the exchange, and thus the attention of the operator is called to the subscriber without the noisy ringing of bells. This will greatly ameliorate the conditions of working for the exchange girls, and ought to produce a better service. The opening of these exchanges will give employment to many hundreds of girls. The payments of subscribers will either be annual or on the toll-rate system. In the latter system the subscriber will pay 3*l.* per annum, and 1d. per call when he rings up successfully, and nothing, of course, when he is rung up. One effect of this toll-rate system will be to make the majority of shops public call offices.

PARIS EXHIBITION:

NOTES ON ENGINEERING EXHIBITS, &c.

AMONGST exhibitors of cement in Group VI. the Société Générale & Unique des Ciments de la Porte de France should be mentioned. The works of this firm were established at Grenoble in 1842 for the manufacture of Portland cement from a stratum of stone discovered by M. Félix Breton, a retired Colonel of Engineers. A useful little pamphlet is published by the company giving sections of water conduits, sewers, roads, and cornices, together with the most suitable proportions for adoption in works of this kind. An interesting stand in the same section is that of the Bridgewater Portland Cement Company, Limited, Somerset. Examples of a new paving material are exhibited in Class 28 of the same group by the Cie. du Granit-Asphalte of Paris. This system of paving is recommended as being hygienic and non-slippery, and practical examples may be seen in the arrival courtyard of the new Gare de Lyon, and in the courtyard of the new Gare d'Orléans, in Paris.

Class 28 also contains a small but noteworthy exhibit of sound-resisting parquet and paving, consisting of a light, non-combustible material termed "Liége agglomerate," and made by M. C. E. Bourry, of Paris. A small structure is shown for the purpose of demonstrating the practical application of this substance in the formation of floors, roofs, and partitions.

In the Palais des Mines several large displays of constructional iron and steel will be found worthy of close inspection. One particularly noticeable trophy is that of the Cie. Française des Metaux, consisting largely of solid drawn copper and tin tubes. About halfway down this building the Expanded Metal Company of France has a stand, where the visitor may witness the operation of a machine used in the production of this familiar material.

We may here also direct attention to the testing machines exhibited by Messrs. Olsen & Co., of Philadelphia. The stand of this firm is situated in the machinery palace, Class 22, and it includes apparatus suitable for testing many different kinds of materials. A new impact testing machine is shown, where the falling weight is at the end of a light pendulum bar, and the force applied at each blow is indicated by the scale on an inverted quadrant of the same radius as that of the arc described by the weight. This machine is used in Cornell University, U.S.A., in the Royal Navy yard, Spezia, Italy, and in other well-known establishments. An automatic appliance for cement testing has lately been introduced by this firm. The load can be applied at a regular rate at any weight varying from 100 lbs. to 600 lbs. per minute, the rate of application being obtained by operating the beam from a shaft of constant velocity. Improved grips, hung on pivot-bearings, ensure a perfectly straight pull on the specimens. The full capacity of the machine is registered on the beam, and the small divisions are shown upon a dial vernier provided at the beam end. Another apparatus which ought to be seen is Olsen's Autographic testing machine, with micrometer attachment. The capacity of the apparatus is from 100,000 lbs. to 200,000 lbs., and it is intended for testing metal, stone, cement and other materials. By the micrometer attachment a multiplication of 500 times is obtained, and the actual conditions of each test are recorded on a diagram card. Power for operating the machine is derived from two belts, and two electric circuits are required, one for the beam poise, the other for the pencil on the recording cylinder. The Cresson gold medal was awarded by the Franklin Institute for this machine. Amongst other exhibits Messrs. G. Salter & Co., of West Bromwich, show one of the well-known Kuhlmann testing machines for cement. Messrs. Brown & Sharp, of Providence, U.S.A., exhibit at Vincennes a selection of measuring instruments and tools for architects and engineers, but principally for the latter.

Machinery and appliances used in the manufacture of cement, bricks, tiles, and earthenware goods are to be found both in the Palace of Civil Engineering and in the decoration and furniture departments on the Esplanade des Invalides. French machinists appear to deal in a fairly comprehensive manner with the requirements of the important industries in question, but their exhibits in general are not particularly novel, nor are they striking from an engineering point of view. In Class 28, M. Charles Morel shows some useful appliances for cement manufacture, including a workman-like crushing machine with jaws; a vertical mill in which grinding is performed by the action of centrifugal force upon four heavy balls, and a sifting machine with conical screens, to which two movements are imparted, one vibratory and the other rotary. The meshes of the upper sieve are kept clear by two fixed brushes, and sifted material can be delivered into sacks from an outlet at the bottom. Particles too large for passage through the second sieve are ejected through an orifice at the side of the collecting hopper.

MM. Chambrette-Bellon & Cie., of Bèze (Côte d'Or), make a speciality of plant for bricks, tiles, and pottery. The machines exhibited are worthy of inspection, and are characterised by solidity of construction, although in some instances the design might advantageously be modified. A selection of clay-working machinery is exhibited by M. G. Lacroix (de l'ancienne maison Boulet, Lacroix, & Cie.), of Paris. This maker issues a pamphlet which, although termed a catalogue, is rather an epitome of plant and machinery intended for use in quarries, and in brick, tile, and pipe works. Notwithstanding the comprehensive manner in which the subject is treated, this book affords a typical indication of the backwardness exhibited by the French in some departments of mechanical engineering. Amongst numerous well-worn woodcuts representing appliances of primitive appearance, a few process-blocks of newer machines are interspersed, whilst the most modern illustrations and descriptive matter refer to drying plant and accessories, chiefly of American manufacture.

Turning to the foreign section we find some excellent examples of Swiss ingenuity and mechanical skill in the machines exhibited by M. Adolphe Buhler, of Uzwill. The most noteworthy of these is a Broyeur-Mélangeur, or mixing mill for clay in a humid state, and invented by M. J. Schmidheiny. This apparatus consists essentially of three or four vertical mills in series one above the other, turned by a central shaft common to all and actuated at the upper end either by belting or by an electric motor. The material is fed into the top pan from a suitable stage or platform. The grinding cylinders are case hardened castings revolving on their own axes, and travelling in a circle around the central shaft in pans with perforated bottoms permitting the passage of crushed stones or other foreign substances. Repetition of the process in other mills of the series effects the adequate mixing of the material and its reduction to any desired state of subdivision. One form of the multiple mill is made so that each unit may be attached to girders supported by the walls of a building. Other forms are entirely self-contained, the several mills being fixed between four cast iron columns three of which are continued to afford support for the gearing. In the larger plants of this type circular galleries are supported by brackets outside the columns giving access to the lower stages, but the top pan is always approached by an upper floor or staging.

Ingeniously hidden in a colonnade facing the central avenue of the Esplanade des Invalides is a most interesting enclosure occupied by a complete brickmaking plant manufactured by the American Clay-Working Machinery Company, of Bucyrus, Ohio. The other specialties of this firm are tile, sewer-pipe, roofing-tile, terra cotta, and clay refining machinery. The company is also interested in the Bucyras steam Tunnel-Dryer for brick and tile work. Owing to the unfortunate loss of the s.s. *Pauliac* the original shipment of machinery for the Exhibition found a resting-place in the Atlantic. A new exhibit for Paris was therefore necessary, and although the works were occupied day and night in the endeavour to cope with other demands, the first plant was duplicated within ten days. That is the American way of business; some day we hope it may be the English way. We can only refer specifically to two machines shown by this firm. The first is the Eagle double-die brick press for re-pressing paving brick and face brick, in either plain or ornamental shapes. Bricks or blocks of clay to be treated are produced in an ordinary brick machine; they are placed on an automatic feed attached to the feeding-table of this press. They are then forced automatically two at a time into steel-lined mould-boxes and subjected to full pressure from above and below. The lower pressure foot continues its upward motion, carrying the re-pressed bricks to the top of the moulds. Here they are automatically pushed towards and removed by the delivery belt,

from which they are transferred by "hackers" to the drying cars. This cycle of operations goes on continuously during the running of the machine. The press moulds are stationary; downward pressure is effected by a cross-head actuated by cranks and hammered steel connecting rods at each end; upward pressure is exerted by a cam on the main shaft, operating in connexion with the lower cross-head. This machine weighs 7,500 lbs. and occupies a floor space of 8 ft. square. The power required is about 2 h.-p., and the output averages about 2,000 bricks per hour.

The second machine for mention is the Giant Auger machine, of a kind suitable for the making of building, paving, and fire bricks, hollow building blocks, drain pipes, &c. For the purpose of this machine the clay should be thoroughly plastic, and of such consistency that the product can be "hacked" as soon as made. Clay is inserted into a feed opening, 18 in. square, at one end of the cylindrical body. It is then forced forward by the knives and auger on the main shaft, so that it is compressed in the conical end of the cylinder, and forced through the die. When the machine is used in brick manufacture the material emerges as a solid clay bar of extreme density, which moves along an endless band to the cutting table. The machine is self-contained and of massive construction throughout. It has a forged steel shaft with heavy gearing of cast steel, and all the bearings are fitted with dust-proof oil chambers. Removable hard metal discs sustain the wear due to end thrust; the casting in the back gear frame holding the discs forms an oil reservoir, and the discs are grooved so that oil may be distributed equally over their surfaces. The augers are of hard, polished white metal, and the knives are of forged iron faced with steel. Augers of different shapes are supplied according to the class of work, and the knives can be shifted to various positions to regulate pugging capacity and rapidity of feed. Motion is communicated by a friction clutch pulley 42 in. diameter by 10 in. wide, running at 200 revolutions per minute; the floor space occupied by the machine is 12 ft. by 6 ft., and the weight is 7,000 lbs. About 3,000 bricks per hour is the average output of the machine shown at Paris, which requires from 25 h.-p. to 30 h.-p.

The cutting table working in conjunction with the Auger brick machine is of the automatic oscillating type, and whilst making a cut it travels with, and at the same speed as, the bar of clay. A perfectly rectangular cut is thus ensured, and upon its completion the cutting device is automatically thrown out of gear, and the frame is brought back to its original position for the next cut. Owing to the oscillating movement, the wires always move in a downward shearing direction, and cutting is performed during the forward and the backward motion. The cutting bars are driven by cranks at each end of the machine, thus ensuring correct alignment and an even cut. Rollers are provided which lubricate the under surface and sides of the clay bars to prevent sticking, all the rollers being supplied with oil from a small overhead tank. The table is built of iron and steel, all working parts moving on anti-friction rollers. It is built with an endless delivery belt, which travels slightly faster than the clay, and thus facilitates the operation of removal to the drying cars. From 2,500 to 4,000 bricks per hour can be cut on this machine, which, with 10 ft. of delivery belt, occupies a floor space of 15 ft. by 5 ft., and weighs 2,600 lbs.

Leaving brick-making machinery, we find a solitary example of masonry plant in the group devoted to mechanical engineering. Trier's patent stone-dressing machine, which is here exhibited in working order, cannot be described as a novelty, as the inventor has already received gold and silver medals from the Paris Exhibition of 1878 and from the Health and Inventions Exhibitions of 1884 and 1885. The essential feature of the machine is to be found in the circular cutters which revolve as they are moved up and down the surface of the stone. In this way all irregularities of the material are split off by a rolling wedge-like action, leaving a true surface with straight toolmarks at right angles to the length of the stone. The stone is carried on a table running on a planed bed, and progressive motion is imparted by suitable gearing. The table is fitted with wheels, so that it can be run on rails from any part of the yard up to the bed of the machine. By the employment of cross trolleys and return rails two or more tables can be used, thus reducing to a minimum the time occupied in the operation of changing stones. Adaptations of the same principle are found in grindstone and emery wheel dressers exhibited by the same firm. One important advantage possessed by all these appliances is that practically no dust is communicated to the atmosphere, as the small particles detached by the cutters gravitate at once to the floor. This characteristic requires no recommendation to engineers who have machinery in the vicinity of grinding appliances, or to stonemasons who study the well-being of their employees.

In wood-working machinery, the French exhibits are more remarkable for the superficial area covered than for novelty or excellence of design. Some ingenious saw sharpeners are, however, well worthy of inspection. The well-known Swedish firm, Messrs. Bolinders, have a remarkably fine show of wood-working appliances, and there are various types of saw-sharpeners both in the Swiss and German sections. Amongst American exhibitors the stands of Messrs. Fay & Egan and the Symonds Saw Company ought to be seen. Messrs. Baker Bros., of Toledo, Ohio, show the Colburn universal saw-bench, with attachments rendering the machine extremely useful for small workshops where several different kinds of work have to be performed.

The Oliver wood trimmer, made by the American Machinery Company, of Grand Rapids, Michigan, is to be seen in several types, some for attachment to a bench, and others provided with independent stands. Briefly described, the trimmer consists of a double-edged knife, triangular in form, and actuated by a lever, at the end of which is a pinion engaging a rack bolted to the back of the knife-blade. A substantial metal frame affords a fulcrum for the lever and guides for the knife. The frame has a rectangular opening and is bolted to a planed bed having adjustable gauges, by which the wood to be trimmed can be set at any angle. Although in no way competing with power-driven machine tools, this trimmer will frequently prove to be a most handy and economical substitute for the hand-saw and the chisel.

So much is heard in the present day of American superiority in every department of engineering, that it is always gratifying to recognise merit in the productions of our own manufacturers. We have seen no American wood-working machines which equal those exhibited at Paris by Messrs. A. Ransome & Co., of London and Newark. So far as general design is concerned, these machines are characterised by correct and graceful proportions, whilst all their mechanical details have been carefully considered and properly carried out. Owing to the limited area obtainable at the Exhibition, only a few representative machines are on view in Paris, and because of our own limits of space, we can only mention two or three of these examples.

Ransome's patent cross-cut steam saw, working for part of its length in guides, is directly attached to the piston-rod of a steam cylinder of small diameter and long stroke. The cylinder is pivoted on gudgeons supported by a carriage, the lower face of which has planed grooves and runs on a cast-iron bed. The pivoting motion is controlled by a hand-wheel turning a worm which gears into a quadrant cast at the end of the steam cylinder, and the sliding carriage can be moved longitudinally by a hand-wheel and screw. This machine is intended for cross-cutting logs in saw-mill work, and is produced in two sizes, for logs of 4 ft. and 6 ft. diameter, requiring 2 h.-p. and 3 h.-p. respectively. A high-speed single deal and flitch frame, for rapidly re-sawing deals and flitches into boards of various thicknesses, is a very fine machine. The feed can be instantaneously varied from 1 ft. to 10 ft. per minute. Fifteen saws are carried by the machine, for which about 6 h.-p. is required. Another good tool is a circular saw-bench with automatic roller feed. The fence is fitted with rollers, and may be set at any angle; a corresponding adjustment of the feed roller is also possible, so that proper bearing surface may be ensured when bevelled material is being cut. We noticed an admirably designed combined saw-bench for light work. Two saws are carried, one for ripping and the other for cross-cutting, either of which can be brought into work at pleasure.

Ransome's moulding machine, designed for working stuff up to 7 in. by 3 in., is driven at unusually high speed, in order that a rapid feed from 20 ft. to 50 ft. per minute may be maintained without deterioration in the quality of the work. Other tools deserving examination are a combined trying-up, planing, and thicknessing machine; a single spindle upright moulding machine with safety circular fence; a joiner's tenoning machine in which the table is mounted on ball slides; and an automatic cutter grinding machine for plane irons, entirely dispensing with retouching by hand. The most striking machine in Messrs. Ransome's exhibit is the "Marbut" rapid moulding carver. It would be difficult to describe the mechanical details of this machine without diagrams, but generally it may be explained that carved designs are cut upon plain mouldings by groups of chisels fixed in separate slides, which are actuated in different directions by suitable mechanism, whilst two of the slides have a circular movement for the execution of convex or concave designs. An endless steel band with projecting pins serves to carry the moulding past the chisels, and its motion is momentarily checked during each stroke. An endless variety of designs can be produced by chisels of different forms, and mouldings may be carved up to 8 in. wide by 3 in. thick, with two or three lines of carving on the different members. On the occasion of our visit a pattern was being executed in a state of perfect finish at the rate of about 1,000 ft. run per hour; but we understand that smaller mouldings can be worked at a speed of 2,400 ft. in the same time.

While we are anxious to do justice to the ingenuity and finish of Messrs. Ransome's machine, it is hardly necessary to say that our praise of it in this respect is not to be taken as implying any approval of machine carving, which we regard as an entire mistake, and we can only wish that the talents of the designer and makers of this machine had been applied to some less questionable object.

Another interesting exhibit is that of Messrs. Thomas Robinson & Son, of Rochdale. This firm is not only engaged in the making of wood-working machinery, but also owns extensive saw-mills and joinery works. The behaviour of different machines can, therefore, be studied first hand by the makers, who are consequently the better able to appreciate and to remedy any constructional or other shortcomings. During recent years visits have been paid by practical members of the firm to other countries with the view of acquiring information as to the nature of foreign timber and as to the most suitable methods of treatment. Our general impression of the machines shown at Paris is that they are massive, rigid, and essentially workmanlike tools. Large wearing surfaces and wide belt pulleys are invariably provided; all bearings are of the self-lubricating type, and the moving parts appear to be well balanced. An improved sand-papering machine, having a cylinder 30 in. wide, with reciprocal as well as rotary motion, is worth examination. Although the time-hallowed expression "sand-papering" is used, the covering of the cylinder actually consists of glass-cloth. A second machine which attracted our notice was Young's patent diagonal dovetailing machine for jointing boxes and other light work, and another was a chain-cutter mortising machine of improved construction suitable for timber of any size up to 12 in. deep by 6 in. wide. In this machine the familiar chisel is replaced by a series of cutters mounted, according to the width of mortise required, on a vertical revolving chain moving down to the wood, through which the cutters eat their way. The advantages claimed for this method of work are that no boring or boredriving is required, and that reversing on short mortises is rendered unnecessary.

MM. Sussfeld, Lorsch, et Cie., of Paris, show a complete outfit of box-making plant by the Morgan Machine Company, U.S.A., including machines for dovetailing, assembling, and finishing. There is also a nailing machine which may be used for fixing the bottoms of boxes, either in conjunction with the previously mentioned set, or as an independent appliance.

Messrs. A. B. Miller & Co., of London and Glasgow, exhibit the Doig box-nailing machine, another American invention, capable of turning out packing-cases up to 56 in. by 40 in. by 40 in., and driving fifteen nails at one operation. Two machines are generally used together, one for framing and nailing the sides, the other for putting on the bottom.

Both in the Champ de Mars and in the annexe at Vincennes an infinite variety of machine tools and other metal-working appli-

ances are on view. In this department of industry British machinists fairly hold their own so far as intrinsic merit is concerned, but it is distinctly noticeable that American firms are very much more at home on the Continent than our own people. A great number of the leading American houses have permanent agencies in Paris, and not a few stands are under the exclusive control of Frenchmen, many of whom do not include a knowledge of the English language amongst their other accomplishments.

The Q and C Company, of Chicago, are makers of stationary and portable cold sawing machinery for iron and steel bars, I-beams up to 15 in., and light architectural steel sections. One type of the Bryant sawing-machine with revolving base and electric motor is specially useful for sawing long pieces at any required angle. An automatic saw-grinding machine shown by the same firm is an effective and well-made tool.

An electric 30-ton travelling crane, built by the Shaw Electric Crane Company, of Muskegon, Mich., to be seen at Vincennes, was used for erecting all the machinery in the American Pavilion, some 3,500 tons in all. This crane is of the four-motor type, having two motors for each hoist, one for the bridge and one for the trolley. It has an auxiliary 5-ton hoist.

Another powerful lifting appliance, an electric "grue titan," by M. J. le Blanc, of Paris, which was employed for erecting heavy machinery, remains as an exhibit in the French machinery gallery on the Champ de Mars. It is in the form of a massive gantry carrying a bridge of inverted bow girders on which the hoisting gear is placed. There are three running wheels on each side, the central wheel of each set being geared by bevel teeth to a long rod extending to the top, where it is operated by electric power.

In the Foreign machinery gallery there is a very striking electric traveller capable of lifting 25 tons to a height of over 40 ft. and having a range of 85 ft. This appliance, built by Herr Carl Flohr, of Berlin, has a skeleton frame of arched form, composed of light braced girders, and its total width is close upon 219 ft. The lifting hook is worked by two 18 h.-p. motors, the carriage by a 8 h.-p. motor, and the crane by a 35 h.-p. motor; the approximate rates of working being 20 ft., 130 ft., and 118 ft. per minute respectively. The electrical equipment was furnished by the German Thompson-Houston Company.

An excessive amount of space was originally provided for civil engineering exhibits, and we presume the absurdly lavish display of cabs, carts, and other vehicles was interpolated in this section as an afterthought, when it was discovered that docks, canals, bridges, and other extensive public works would not be forthcoming as exhibits. Most of the plant used by contractors for civil engineering works is, of course, to be found in other parts of the Exhibition, but there are many interesting stands and a large number of valuable drawings and models in the Palais du Génie Civil.

Immediately adjoining the tasteful enclosure of the Austrian Society of Engineers and Architects is a collection of drawings and models contributed by the Commission for Canalisation of the Molday and Elbe in Bohemia. Amongst the models are some representing barrages, steel "fermettes du barrage," excavators, dredgers, and other auxiliaries. Some useful information on the subject of dredging may be acquired by a visit to the stand of the Société anonyme "Chantiers Conrad" de Haarlem. M. J. Massalski, who represents this company in Paris, was a delegate from the French Society of Civil Engineers to the International Congress of Navigation held at Brussels in 1898, and is the author of some interesting contributions upon dredging operations to the transactions of the Society.

MM. Sulzer Frères, of Winterthur, have a realistic stand in the Civil Engineering Section showing the rock-drilling apparatus employed on the Simplon Tunnel, and a memoir giving some particulars relative to this undertaking is published by the firm.

The Ingersoll-Sergeant Drill Company of New York has exhibits both in the Machinery Section on the Champ de Mars and in the Mining Department at Vincennes. At each place air-compressors and rock drills are shown of types suitable for mines, quarries, railway cuttings, tunnels, canals, and submarine rock work.

An ingenious form of conveying apparatus is exhibited by the Robins Belt Conveyor Company, of New York. Briefly described, the conveyor is an endless moving trough formed of cotton belt having the inner surface protected by a lining of indiarubber, which is thicker at the centre than at the sides. The loaded belt runs on idle pulleys, arranged in sets of three, the centre pulley being horizontal and the other two at an angle to curve the belt into a trough-like form. Sets of three horizontal pulleys are fixed for the returning line of unloaded belt. Hollow shafting is used for the pulleys so that grease enters the bearing at the centre, towards the ends of which it is forced, thus forming a dust-proof collar. Two model conveyors in the Palace of Mining and Metallurgy and two full-sized conveyors at Vincennes are fitted with "trippers" capable of discharging the load at any point or points along the line of the conveyor. Trippers consist essentially of two pulleys in a suitable framework, and the belt is caused to pass over the pulleys so as to describe a course similar in form to a letter S. At the first downward turn the load is discharged into a shoot leading to one side of the conveyor. But as only part of the material has to be unloaded at the point selected, the tripper is made automatic by the provision of a two-way shoot, one branch delivering into a hopper or bin, and the other leading back to the conveyor. Then, when the hopper is full, the material continues to progress along the belt uninterrupted by the tripper. By this arrangement material can be deposited at a number of points in the line of a long conveyor. Sometimes a moving tripper is applied, to which motion is imparted by the belt itself in such a way that the tripper travels constantly backwards and forwards along the conveyor, discharging its load as it goes. The Robins conveyor is largely used in the United States for transporting ore, coal, gravel, sand, and excavated materials generally.

An idea very prevalent in the United States is that, when a given work has to be done, the best plan is to get it over quickly and start the next job. The Goodwin car is one outcome of this sentiment. It is built entirely of plate steel, angles, and malleable iron castings, and will carry 80,000 lb. weight, or 30 cubic yards. From it any material capable of passing through an opening of 16 ft. by 4 ft. can be promptly discharged simply by the gravity of the load itself, and without tilting or moving the car body in any way. Unloading can be effected on either or both sides or in the centre, and the angle of discharge is 31 deg. from the horizontal. A train of cars can be promptly unloaded, as all the hinged sides and bottoms are under the control of mechanical appliances, which can be operated simultaneously by one man from any part of the train. If discharged when the car is running, the load spreads from 5 ft. to 30 ft. from the track, according to the speed. The car has been successfully employed in connexion with reservoir and railway construction in the United States, and a train of cars is now in use by the Great Northern Railway Company. No doubt the main idea is an old one, but its realisation on this extended scale and in this eminently practical form is new.

Another old idea which is being taken up seriously in the United States is that of pneumatic despatch. We all know the system was first applied in London nearly half a century ago, and that it has since then been largely adopted by the postal service. In no case, however, do the tubes used in this country exceed 3 in. in diameter, consequently only letters, telegrams, and very small packages can be transmitted, and no successful attempt has hitherto been made to deal with the conveyance of merchandise. An improved system, devised by Mr. Batcheller, is illustrated at Paris by the exhibit of the Pneumatic Transit Company, of Boston, U.S.A., who have already laid down complete installations with 6-in. and 8-in. tubes in Boston, Philadelphia, and New York for the postal authorities, and are now preparing to organise services in which parcels will be delivered by the aid of 12 in. tubes. In the Batcheller system bored tubes, similar to cast-iron water pipes, in 12 ft. lengths are used for transmission. Short bends are of seamless brass tubing $\frac{1}{8}$ in. thick. The carriers are thin cylinders of steel closed at the front end by a convex disc of steel carrying a buffer of felt and leather, whilst the back end is closed by a hinged lid secured by a lock. The tubes are jointed with yarn and lead, and are supported on a firm foundation of concrete; the brass bends are covered with about 8 in. concrete, or brick laid in cement. Ingersoll-Sergeant Corliss type air compressors furnish the motive power in large installations, and the pressure used does not exceed 25 lbs. per square inch. Inasmuch as building materials are chiefly classified with decorations and furniture, and as domestic heating and ventilating apparatus finds a home in the Palace of Agriculture and Food, it is by no means surprising that some models exemplifying American building construction and domestic engineering should be grouped with civil engineering and means of transport. Although English architects may not be disposed at present to adopt the American system, they will find some interesting features in the exhibit prepared by the George A. Fuller Company, building constructors, of New York. A complete model of the skeleton framework of the Broadway Chambers building, New York, is exhibited, in which every structural detail is faithfully reproduced, from the foundations to the roof. The work is neatly executed in copper, to scale, and comprises 25,000 separate pieces. Three sectional models to larger scale represent the methods of floor and wall construction at different stories. A model in plaster to the scale of half an inch to the foot reproduces the building in full detail. There are also architectural and engineering drawings relating to the same structure, and some photographs showing the rapidity with which buildings of this class are erected. Exact particulars are furnished with regard to the engineering plant, including steam boilers, engine, dynamo, as well as to the systems of heating, lighting, plumbing, and sanitation.

The objects which we have mentioned incidentally and in detail are sufficiently numerous, but they present a very inadequate picture even of the isolated sections of the Exhibition, to which our notice has been more particularly directed.

THE BRITISH ASSOCIATION AT BRADFORD.

THE annual meeting of the British Association was opened at Bradford on Wednesday, the 5th inst. Considering the number of congresses held this year, it is not a little remarkable that the Bradford meeting should have turned out so successful. At the same time, many prominent scientists were missing, and, if we may say so, the whole meeting was rather amateurish. The value of the British Association meetings is always marred to a great extent by the unbounded hospitality showered upon the members, whereby the scientific aspect of the congress is often lost. Bradford has not been behind other cities in showing that it knows the way to receive visitors, and some sections have greatly profited, both scientifically and in the spread of general knowledge, by visits to works and factories in the vicinity.

On Wednesday evening the President, Sir William Turner, Professor of Anatomy in the Edinburgh University, delivered his address on the structure and history of the cell as the basis of life.

On Thursday the main work of the day was the reading of the presidential addresses in the several sections. These were of abnormal length, some almost rivalling the address of the President of the Association in that respect. Several were merely accounts of the development of the particular science treated of during a long series of years—short histories, in fact, that could be read in text-books. The address of the President of the Chemistry section dealt with the "Modern System of Teaching Practical Inorganic Chemistry and its Development." He pointed out the necessity for reform in the teaching, particularly that instead of much of the usual qualitative and the quantitative analysis, practical exercises similar to the following would be found to be of much greater educational value, viz.—(1) The careful experimental demonstration of the fundamental laws of chemistry and physical chemistry. (2) The preparation of a series of compounds of the more important metals, either from their more common ores or from the metals themselves. (3) A course in which the student should investigate in certain selected cases:—(*a*) the conditions under which action takes place; (*b*) the nature of the products formed; (*c*) the yield obtained. (4) The determination of the combining weights of some of the more important metals.

The President of the Geology Section, whilst expatiating on the great advances made in the study of geology during the nineteenth century, did not improve the position of the science by mentioning some absurd theories as to the number of years that have elapsed for the bringing about of certain evolutionary phenomena.

Sir Alexander Binnie, President of the Mechanical Science Section, dealt with several matters of general interest to mechanical engineers, drawing upon history for the illustration of many of the subjects introduced.

Mr. James Watson, Waterworks Engineer to the Bradford Corporation, was a little more practical in a paper read before the same section on water supply. He said the works for the supply of the city of Bradford were of ancient origin, dating back to 1744, when a small company of ten shareholders subscribed the money to bring water from the hills by means of pipes. In 1790, when the population was 6,000 (it is at present 300,000), an Act was obtained for improving these works. In 1854 the Corporation acquired the property. The population served at present is 450,000 (including "out towns"); the daily average consumption is 12,000,000 gallons, or about 26½ gallons per head per day. Within the city, however, the consumption for all purposes is 41 gallons per head per day, though of this quantity 21 gallons were for trade purposes. Another interesting paper was read by Mr. John McTaggart on the disposal of house refuse in Bradford. In 1880, he said, they had a refuse destructor of six cells, which were subsequently doubled. In 1897 these and other cells which had been erected were pulled down and replaced by a destructor of the Horsfall type, and in the present year the Horsfall Company was given the contract for building twelve more cells. The total quantity of refuse collected is 125,000 loads per annum. The by-products of the destructor were referred to, amongst which are bricks, paving slabs, cement, concrete, &c. A new destructor is about to be built; it is estimated that when complete it will be capable of destroying refuse at a cost of 5½d. per ton for labour only, and it is hoped that finally the whole of the house refuse of the city will be destroyed without nuisance and without cost.

In the section of Anthropology Professor John Rhys, the President, delivered his address on the early ethnology of the British Isles, the subject being approached from the standpoints of language and folklore. In the afternoon Mr. Arthur Evans read an important paper on "Writing in Pre-Historic Greece," based on discoveries made in his recent excavations in the Mycenæan palace at Knossos, in Crete, the latest elements of which, he said, could hardly be brought down later than the thirteenth century B.C. The clay documents found consist of two apparently contemporary classes—viz. (1) those with hieroglyphic or conventional pictographic script; and (2) those (forming the majority) inscribed with linear script, and exhibiting a free, upright style of writing fundamentally different from that of the hieroglyphic class, and far ahead of it in development. In this latter class some seventy characters seem to have been in common use, and of these about ten show resemblance to the later Greek, ten to the Cypriote syllabary, and [illegible] were common to this class and the hieroglyphic class. In the first class the hieroglyphic script shows a certain parallelism with the Hittite inscriptions of Anatolia and Northern Syria. In the same section Mr. F. H. Griffith contributed a paper on the system of writing in ancient Egypt.

After the President's address had been read in the Botany section Mr. Samuel Margerison read a paper on "British Sylviculture." He pointed out that recent supplies of timber were largely foreign, though there was much land in this country at present only slightly productive which might be put to better and more economical use. The crops produced by Continental sylviculture are treble or quadruple those grown in Britain.

On Friday, in the Chemistry section, Mr. F. H. Neville read the report of the committee on the Nature of Alloys. It was stated that most students believed that certain definite chemical compounds existed in alloys. To prove this, however, certain means must be adopted to abstract the particular compounds. Ordinary chemical means of isolation were of no use under the circumstances. Fractional solution was effective in some cases, and by means of it several distinct metal compounds had been isolated from alloys, such as platinum-tin, copper-tin, zinc-copper, and other compounds. Another method was by observation of the "freezing point"; the molten mixture was cooled down slowly and the temperature noted at which solid matter began to separate from the liquid. This varied with the proportion of the constituents, and by making many observations with varying proportions, a curve could be obtained of these solidifying temperatures, any irregularity pointing to the formation of something other than a mere mixture. By this means many interesting facts had been indicated which had subsequently been rendered evident by examination under the microscope. A long list of known and supposed alloy compounds was given in the report, and it appeared that the atomic relations generally recognised by chemists did not hold good in the case of alloys.

In the Geology Section, amongst other papers, the Rev. W. Lower Carter presented a report on the underground waters of north-west Yorkshire.

The Mechanical Science Section considered a paper by Professor Hele Shaw on the "Resistance of Road Vehicles to Traction." The recent remarkable development of motor vehicles with a legal limit of speed as high as twelve miles an hour, and the generally increased speeds of tram-cars in cities owing to the introduction of electricity and steam, give, the author thought, some reason for thinking that the general rate of speed on common roads might reach, or even exceed, the present legal limit applying to motor vehicles. Forty or fifty miles an hour had been safely maintained for more than 300 miles upon the common road in France. Another paper, by Mr. W. T. E. Binnie, was read, containing a description of a self-registering rain gauge, in which the record is obtained by collecting the fall in a funnel, at the delivery orifice of which is an ingenious device for maintaining a uniform size of drop. The recording part is electrical. Each drop as it falls is caused to make and break contact, and in this way a diagram is traced on a revolving paper drum. A short discussion followed the reading of the paper, in the course of which members spoke of its great promise as enabling a check to be kept on the existing forms of gauge.

An interesting paper was read by Mr. A. T. Walmisley on the "Use of Expanded Metal in Concrete," which we print on another page.

One of the most interesting communications made on Saturday was by Sir W. H. Preece, in the Section of Mathematical and Physical Science, on the subject of wireless telephony. The first experiments in this direction were made, he said, in the month of February, 1894, across Loch Ness, in the Highlands, when trials were made to determine the laws governing the transmission of Morse signals by his electro-magnetic method of wireless telegraphy. Two parallel wires well earthed were taken, one on each side of the lake, and arrangements were made by means of which the wires could be systematically shortened, with a view of ascertaining the minimum length necessary to record satisfactory signals. It occurred to Mr. Gavey, who was experimenting, to compare telephonic with telegraphic signals—*i.e.*, to ascertain whether articulate speech could be maintained under the same conditions as Morse signalling. The trials showed that it was then possible to exchange speech across the loch at an average distance of 1½ mile between the parallel wires when the length of the wires themselves was reduced to four miles on each side of the water. The sensation created in 1897 by Mr. Marconi's application of Hertzian waves distracted attention from the more practical, simpler, and older method. Mr. Evershed and Principal Oliver Lodge had in the meantime much advanced the system by introducing admirable call systems. In 1899 the speaker conducted some careful experiments on the Menai Straits which determined the fact that the maximum effects were produced when the parallel wires were terminated by earth plates in the sea itself. It became quite evident that the ordinary inductive effects were much enhanced by conductive effects through the water, and that in consequence shorter wires were practical. No special apparatus seemed necessary, and the ordinary telephonic transmitters and receivers were used. It became desirable to establish communication between the islands or rocks known as the Skerries and the mainland of Anglesey, and it was determined to do this by means of wireless telephony. The lighthouse at the Skerries was wanted to be in communication with the coastguard station at Cemlyn, the latter being connected with the Post Office system. The bottom of the channel being too rough and the currents too violent for a cable, a wire 750 yards in length was erected along the Skerries, and on the mainland one of 3½ miles from a point opposite the Skerries to Cemlyn, each line terminating by an earth plate in the sea. The average distance between the parallel portions of the two wires was 2·8 miles. Telephonic communication was readily maintained and the service was a good one. Further experiments with wireless telephony had recently been made between Rathlin Island, on the north coast of Ireland, and the mainland. The east and west portion of the island of Rathlin was about eight miles from the mainland, but a tongue of land projected southward to within a distance of four miles. Communication was required between the lighthouse near the north-eastern corner of the island and the mainland, and the question for solution was whether an overhead line running the whole length of the island from east to west was necessary to obtain good communication, or whether a shorter line across the neck of the southern peninsula would serve. The preliminary experiments proved conclusively that communication, both telegraphic and telephonic, could be readily maintained by means of temporary wires established across the neck of the peninsula along the shorter line. Wireless telephony across the sea was thus now a practical and commercial system.

The Geology Section was entertained by a paper by Professor Sollas on a "Concealed Coalfield beneath the London Basin." The author had, apparently, nothing new to say, and it is difficult to understand why this subject should be threshed out annually before the Association.

On Monday the first paper taken in the Mechanical Science Section was on "The Automobile for Electric Street Traction," the author being Mr. J. G. W. Aldridge. After a reference to the drawbacks and difficulties incident to the usual means of carrying street traffic, he described a system which had been devised in France. The electric motor vehicles derived power from a pair of trolly wires supported on short brackets along one side of the road; on these wires ran a two-wheel trolly containing a small electric motor for its own propulsion, the whole being connected to the omnibus by a flexible cable attached to a pole on the roof, devices being also provided to keep the cable sufficiently taut and to obviate any risk of derailing the trolly. Continuous current at 500 volts was supplied to the omnibus motor via the trolly wheels and flexible cable, which also contained three small conductors which served to convey back to the trolly motor the three-phase current driving it. This was derived from the omnibus motor, which was provided with three collecting rings on the armature at the end remote from the commutator, and connected to suitable points in the winding. By this arrangement synchronism was maintained between the speeds of the vehicle and trolly motor, but in addition there was provided on the trolly motor an electro-magnetic brake which would be energised at will through a sixth wire in the flexible cable. The system was in actual use in the outskirts of Paris. The omnibuses illustrated were specially built vehicles, weighing about three tons empty and five tons loaded, and were furnished with solid rubber tires; at ordinary speeds the power required to propel them was from 130 to 160 watt-hours per ton-mile on level roads.

Two papers were next read on the interesting subject of single rail railways. Mr. William Dawson, Deputy Engineer to the city of Bradford, made a communication on "Recent Tramway Construction," the chief feature in which was a description of the Demerbe rail, which has been in successful use for some time in Bradford. This rail, which differs entirely from other types, consists of a hollow trough rail. The fishplates, by which the different lengths are joined, are placed inside under the ends of the rails and exactly fit their contour, the point of application being immediately under the head of the rail. By means of cotters the fishplates are driven close up to the underside of the rail. When in position the rail is completely filled with concrete. The tie bars are flat. The rail is inserted into two oblique grooves, one of which is cut so as to exactly fit its outer side, while the other is

wider to facilitate its introduction. The space left is filled up with a wedge of soft steel. In this way the rail becomes attached to the concrete foundation and is actually a part of the carriage-way. It will, therefore, withstand the strains caused by the cars and also all other strains and vibrations caused by ordinary vehicular traffic without any loosening of the joints or displacement of the paving. The system has been in use in Leeds six years, and the author considered that no repairs would be necessary during the life of the rail once it is properly laid. The life he would estimate to be about twenty years.

Tuesday, like Monday, did not produce much of interest to our readers. In the Chemistry Section Mr. F. W. Richardson read a paper on "Bradford Sewage and its Treatment." He remarked that Bradford sewage was among the worst in the kingdom, owing to the influx of woolcombers' waste-products and of dyeworks' effluents. It required much precipitant and produced a great deal of wet and settled sludge. Difficulties arose from the peculiar emulsive character of wool-grease and the excessive amount of nitrogenous impurities. Various experiments had been tried with it, with, briefly, the following results:—Lime gave a clear but bad effluent with a large amount of sludge; copperas, followed by lime, produced a turbid but better effluent; aluminia-ferric, *i.e.*, aluminia sulphate, gave unsatisfactory results at a high cost; acid ferric sulphate gave a high degree of purification, but with an acid effluent; neutral ferric sulphate yielded as good results, but with less acidity; and basic ferric sulphate gave a 62 per cent. purification and a neutral or slightly alkaline effluent, but proved costly. With bacterial treatment nitrification ensued and 70 per cent. purification might be obtained, but the grease soon choked the filters. There could be no doubt that if the woolcombers' suds and effluents were entirely removed the whole of the city's sewage could be treated biologically, with an immense saving in the cost of chemicals and the treatment of the sludge. Failing the elimination of the wool-suds, the best method would seem to be a preliminary treatment with the cheapest precipitant obtainable and the biological purification of the effluent, either on bacteria beds or on land, preferably on both.

Amongst several papers read in the Mechanical Science Section was one by Mr. E. Kitson Clark on "Shop Buildings." This contribution comprised a large number of details of what was considered desirable in the construction and arrangement of walls, roofs, floorings, heating, lighting, and other details. The same section was also interested by a communication by Professor Arnold, of Sheffield, on "The Internal Architecture of Steel," which explained the effects of various alloys on the structure and qualities of the metal.

The proceedings of the concluding day, Wednesday, were brief, though there were yet several communications to be disposed of. The Director of the National Physical Laboratory explained to the Mathematical and Physical Science Section the construction of practical standards for use in electrical measurements. His report recommended that a particular sample of platinum wire be selected, and platinum thermometers be constructed therefrom to serve as standards for the measurement of high temperatures. Other papers in the same section dealt with a new form of Wheatstone bridge, and on an improved standard resistance coil.

The usual votes of thanks to the President, the Presidents of Sections, and local bodies and individuals concluded the proceedings.

SUNDAY SCHOOL, LEEDS.—The new Sunday-school premises in connexion with the Woodsley-road Congregational Chapel, Leeds, were opened on the 1st inst. The buildings comprise a schoolroom 55 ft. long and 28 ft. wide, with an open timbered roof 22 ft. high in the centre, and lighted by mullioned windows to the front and one side. Opening out from it are arranged five classrooms, underneath the schoolroom, with both external and internal approaches, and a gymnasium 44 ft. long, 28 ft. wide, and 13 ft. high, with cloakroom, lavatory, &c. The school portion is connected with the chapel by corridors. The new buildings are built of pressed bricks with stone dressings, and all internal work is of pitch pine, the windows being glazed with leaded lights. The whole of the works have been carried out from the designs and under the superintendence of Mr. G. F. Danby, architect, Leeds, at a cost of about 2,100*l.*

ARCHITECTURAL SOCIETIES.

ARCHITECTURAL ASSOCIATION OF IRELAND.—The sketching club of this Association, by invitation of the President, Mr. F. Batchelor, visited on the 8th inst. the installation of the Septic system of sewage disposal on the Burnaby Estate, Greystones. The members, numbering eighteen, were met at the station by the President, who at once conducted them to the site of the septic tanks. The sewage first passes through a storm chamber, where it is separated from an abnormal rainfall by vertical slate slabs, and then into a grit chamber where any stone or gravel brought with the flow is deposited. Thence it passes into the septic tank, a light-proof sunken concrete chamber, 40 ft. by 9 ft. by 7 ft., in which it is acted upon for twenty-four hours by the micro-organisms which multiply enormously in the absence of light. After the resolution of the crude sewage into ammonia water, carbonic acid, and nitrogenous compounds, the tank effluent is conveyed through an ingenious automatic system of valves over the three filter beds, consisting of 4 ft. of clinker, each of the beds being in operation for eight hours. At the conclusion of the process the purified effluent is collected by means of field drain pipes, and is conducted into a neighbouring stream. The system, which is designed for 500 inhabitants, is so planned as to be easily enlarged. The President explained the various points of interest in the scheme, and had the working drawings available for the members' inspection. At the conclusion of the visit the party were entertained to tea at the President's house.

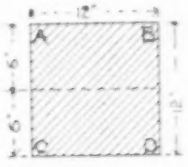
THE USE OF EXPANDED METAL IN CONCRETE.*

THE subject of the judicious introduction of iron and steel sections as a tensile element in the construction of concrete beams and slabs is one which at the present time is very much engaging the attention of engineers.

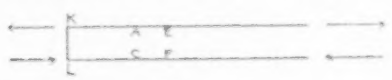
The different kinds of fire-resisting floors are too numerous for comparison upon the present occasion, but in various ways concrete has been combined with fire-resisting materials to form such floors. It is acknowledged that a concrete floor containing a brick aggregate in approved sizes and preferably of firebrick properly mixed is superior to a stone landing, as the latter when exposed to a severe heat so easily collapses. The selection of the aggregate is quite as important in the formation of satisfactory concrete as the use of the best cement. Iron and stone structures are fireproof in the sense that iron and stone are non-inflammable materials, but they are not proof against collapse by fire. Few kinds of stone will endure intense heat without crumbling away, though stone and brick are each capable of retaining their strength at a greater heat than unprotected iron.

Metal has been employed in various continued sections ever since iron and steel plates have been expanded or rolled into various shapes for use in construction, but the special development of a plate into open or lattice work by partially dissevering a solid plate of metal into strands having uncut connecting intersections was only thought of in recent years, and since the paper read before this Association at its Liverpool meeting in 1896 explaining the system of its manufacture, its applicability to various purposes has subsequently been favourably considered, especially for introduction into concrete in order to supply that tensile element which concrete without metal generally lacks.

The attempts of Monier, a Parisian florist, to obtain large vessels of a material more durable than wood and lighter than concrete resulted in the introduction by him of wires embedded in concrete, and after subsequent working out by Herr Gustav Adolph Wayss, of Berlin, rods were introduced in the place of wires, and extensive trials were made in the year 1890 in the building yard of the Royal Hungarian Government at Budapest. Similar efforts have been made with the Hennibique system, in which stirrups are introduced to hold up the tension rods with the object of contributing to resistance of shearing stress. Also in the Matrai system, in which wires are embedded in the concrete diagonally between the supported ends. All these contrivances, however, though very ingenious, need supervision in setting out in order to place the metal inserted in the concrete at the specified distances apart. Metal lathing has also been introduced, that by the Bank's system having been employed in partition work and ceilings made of flat steel wire or ribbon twisted and woven into meshes of convenient size. At first the use of expanded metal was restricted almost wholly to lathing for plastering, in which, as stated upon the makers' catalogues, "the key is the thing," but as the machinery for its development has been improved, it has become recognised as an effective binder for heavy floors, canal walls, docks, locks, and reservoirs, as well as for reclamation walls facing the sea in sheltered positions. The concrete is entangled in the meshes, and continuity of the metal work throughout can be secured by slightly overlapping the sheets. Uniform distribution of strength combined with an effective keyage is also provided, and it needs no special supervision, as when independent rods or plates are introduced, to place the lattice work horizontally in a correct position in the concrete, but as regards its position vertically in the section, we may now profitably consider its effect. In order to appreciate the superiority of expanded metal in affording ample without extravagant iron or steel tensile aid to a slab of concrete, let us for the sake of argument calculate a concrete beam 12 ins. square in transverse section, assuming the neutral axis first of all to pass if possible



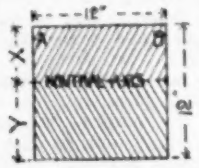
through the centre of gravity of the section. If the beam be supported at both ends of its length, and loaded between the supports, the upper portion will be in compression and the lower portion in tension. The stress will be nil at the neutral axis, and a maximum along the outside top and bottom edges. The safe compressive working maximum stress may be taken approximately at, say, 400 lbs. per square inch, while the corresponding safe tensile maximum working stress would then, according to accepted data, be only 40 lbs. per square inch. Thus it will be seen that with a central neutral axis the beam would theoretically fail in tension long before the compression became prejudicially affected. This tendency to fail in tension would, however, be partially resisted by the fact that practically a flat arch is formed within the beam, which would appear to create the conversion of a large part of the vertical pressure into lateral thrust, but which really causes the section to act as a bar with a hollow curved soffit, and it is evident that the neutral axis under the influence of such a load would not remain coincident with the centre of gravity of the section, but would rise above it, until the tensile and compressive resistances were equal, so that the equilibrium of any short length of the beam resulted in a couple.



Thus, if the panel A E F C is pushed towards the left by a force uniformly applied along a short margin A E at its upper section, its lower section C F will be thrust towards the right with an equal force as represented in direction by the arrows, or vice versa. This couple or pair of contrary forces, if acting alone, would exert upon the panel A E F C a rotating tendency, but we have the vertical effects of the reaction at the supports K L together with the action of the weight intervening between the support and the panel under consideration, K A C L each exercising their influence in the balance of moments round a turning point. The mean stress which can be applied upon the upper portion of the beam $= \frac{400+0}{2} = 200$ lbs. per square inch and that upon the lower portion $\frac{0+40}{2} = 20$ lbs. per square inch. In each case the resistance will be the mean stress of the area influenced, multiplied by two-thirds of the depth of the portion so influenced which we have under

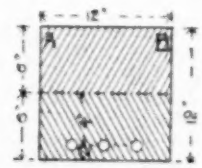
* A paper read on September 7 by Mr. A. T. Walmisley, M.Inst.C.E., before the British Association at Bradford.

consideration, that being the distance of the centres of pressure of the upper and lower portions above and below the neutral



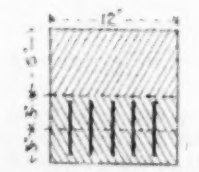
axis. Let X and Y represent respectively the depths of the top and bottom outside surfaces from the neutral axis. Then the resistance of the upper part in compression will be $200 \times (12 \times X) \times \frac{1}{2}X = 1{,}600\ X^2$ inch-pounds. And the resistance of the lower part in tension will be $20 \times (12 \times Y) \times \frac{1}{2}\ Y = 160\ Y^2$ inch-pounds. If these are equal then $1{,}600\ X^2 = 160\ Y^2$ or $10\ X^2 = Y^2$. But $X + Y = 12$, $\therefore X + X\sqrt{10} = 12$ and $X = \frac{12}{4{\cdot}16} = 2{\cdot}88$ and $Y = (12 - 2{\cdot}88) = 9{\cdot}12$. The limit of capability is therefore not a compression of $200 \times (12'' \times 6'') \times 4'' = 57{,}600$ inch-pounds, but $200 \times (12 \times 2{\cdot}88) \times \frac{1}{2}\ (2{\cdot}88) = 13{,}271$ inch-pounds. This divides the depth in the proportion of 24 to 76 instead of two halves, and gives the percentage.

We will now consider the effect of introducing three tension rods in the lower portion



of the beam. To maintain the neutral axis in the centre of the section the quantity of iron with a unit stress of five tons to the square inch needed to furnish the required balance of resistance would be, if applied at the centre of pressure, $\frac{57{,}600 - 5{,}760}{5 \times 2{,}240 \times 4} = \frac{51{,}840}{44{,}800} = 1{\cdot}15$ square in. as the quantity of iron needed to furnish the required resistance. Assuming three rods of $1\frac{1}{16}$ in. diameter equal to three times an area of ·37 square in., we have the requirement approximately attained. The chief requisite in construction is to provide sufficient cover underneath the iron to protect it from the action of fire. Should these rods be only embedded $1\frac{1}{2}$ in. (centres) above the lower edge C D, then their distance from a central neutral axis would be $4\frac{1}{2}$ in., and their diameter would be $\frac{51{,}840}{d^2 \times 3 \times 7{,}854 \times 5 \times 2{,}240 \times 4\frac{1}{2}} = \frac{51{,}840}{151{,}200\ (7{,}854)\ d^2} = \frac{\cdot 43}{d^2}$, or $d = 1\frac{1}{16}$ in. approximately, the same as before, although theoretically each rod would need 16 per cent. less sectional area than when placed $\frac{1}{2}$ in. nearer the neutral axis.

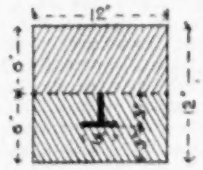
Let us next consider the insertion of 4 in. × $\frac{1}{16}$ in. wrought-iron plates, with $\frac{1}{4}$-in. cross rods and symmetrically disposed in the centre of the



lower half, 2 in. apart, five in number. This gives us 5 (4 in. − $\frac{1}{4}$ in.) × $\frac{1}{16}$ in. = $\frac{7}{64}$ square inches = 1·7 square inches, and $\frac{7}{64}$ square inches × 5 tons (2,240) × $3\frac{3}{8}$ = 43,125 inch-pounds, and concrete (12 in. − $\frac{8}{16}$ in.) = $11\frac{1}{16}$ in. × 6 in. × 20 × 4 = 5,610 inch-pounds; total, 43,125 + 5,610 = 48,735 inch-pounds, so that in this case the neutral axis would become slightly raised above the centre line in order so to increase 48,735 inch-pounds, the tensile element, and to decrease 57,600 inch-pounds, the compressive element, until they form a couple that would produce equilibrium.

To avoid the expense of drilling or of punching the holes for the interlacing rod, Messrs. Lindsay & Co. in their system introduce alternate rods passing over and under the sections of iron or steel, arranged in pairs, thus saving the consequent weakening of the section, and in large floors these rods maintain light rolled joists in position placed a good distance apart.

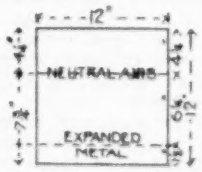
If instead of vertical plates as above we next consider an inverted tee section 3 in. × 3 in. × $\frac{1}{2}$



in. inserted with the top of the metal web touching the neutral axis, we have then from the iron section, first, the stress at the junction of the web with the flange as follows :—$\frac{2\frac{1}{2}}{3}$ or $\frac{5}{6}$ of 5 tons = 9,333·3 lbs.; web $2\frac{1}{2}$ in. × $\frac{1}{2}$ in. × $\left(\frac{0 + 9{,}333{\cdot}3}{2}\right) \times \frac{5}{6}$ ($2\frac{1}{2}$ in.) = 9,722-inch pounds; flange 3 in. × $\frac{1}{2}$ × $\left(\frac{9{,}333{\cdot}3 + 11{,}200}{2}\right)$ × 2·8 = 43,120 inch-pounds, giving a total of 52,842.

The area of cross section of tee iron = 2·75 square inches, and the area of concrete below the neutral axis = (72 − 2·75) = 69·25 square inches, and 69·25 square inches × 20 lbs. × 4 in. = 5,540 inch-pounds, and 52,842 + 5,540 = 58,382 inch-pounds. Supposing the compression of the upper portion above the neutral axis to balance this amount, we should have $\frac{58{,}382}{(12 \times 6) \times 4}$ = 202·8 lbs. per square inch as the working unit stress above the neutral axis, or practically a stress of 200 lbs. per square inch as above assumed.

Lightness, combined with stiffness, may be attained in heavy floors by introducing the tubular system into the compressive element of the concrete, whereby the upper thickness can be placed at a comparatively greater distance from the neutral axis, the increased depth of the beam so attained, supported at both ends, tending to obviate deflection, but the alternative system of introducing hollow lintels below the neutral axis when the upper half depth is covered with solid concrete is unscientific, as it increases the area of the portion subject to compression, while reducing the area of the portion subject to tension, without contributing thereto by the aid of metal. It will be seen that the insertion of wires or rods or bars or other separate sections contributes strength in the direction of length in which they are placed, but are evidently weak transversely, leaving the intermediate concrete unaided.



Expanded metal, however, contributes strength laterally as well as longitudinally. It also provides keyage by its depth. The advantage gained by the lattice shape of the metal, prevents a continuous line of stress as obtained in systems in which the stress is mainlygiven in one direction only, so that with the use of a diamond-shape plate with open centres we have to allow a factor approximately of 2 to compensate for the angle of stress in its weakest direction. Thus, assuming so low a stress as 5 tons to the square inch in order to harmonise with the low units taken in the above calculations, we have $\frac{5 \text{ tons} \times 2{,}240}{2} = 5{,}600$ lbs. per square inch, and supposing we employ expanded metal to "size No. 10^a," having a 3-in. mesh with strands $\frac{3}{8}$ in. by $\frac{3}{16}$ in., *i.e.* $\frac{3}{16}$ in. thickness by $\frac{3}{8}$ in. width of plate we obtain in a width of 1 ft. run, a transverse section of $4\ (\frac{3}{8} \times \frac{3}{16}) \times 2 = \frac{9}{16}$ square inch, capable of sustaining as expanded metal a safe stress in any direction of $\frac{9}{16} \times 5{,}600 = 3{,}150$ lbs., which, if laid $1\frac{1}{2}$ in. above the under surface of the beam, or $6\frac{1}{2}$ in. below the neutral axis (as sketched in the accompanying section) would provide a moment of resistance of 19,687 inch-pounds, which added to concrete (12 in. × $7\frac{3}{4}$ in.) below the neutral axis = 93 square inches × 20 lbs. × $\frac{5}{6}$ ($7\frac{3}{4}$ in.) = 9,610 inch-pounds, giving a total tensile resistance of 29,297 inch-pounds, so that in the portion above the neutral axis we have a unit working stress in compression to balance this amount of $\frac{29{,}297}{(12 \times 4\frac{1}{4}) \times \frac{5}{6}\ (4\frac{1}{4})} = \frac{58{,}594}{289} = 203$ lbs. per square inch, or practically 200 lbs. per square inch as the mean compressive unit strength. The consideration of beams of greater width than 1 ft. would result in the same decision, as the expanded metal would be uniformly increased in width with the concrete.

The present machinery at work at West Hartlepool is limited to sheets of 8 ft. in length, but larger machines are in contemplation to enable sheets of wider areas to be supplied. In order to maintain a definite distribution of the character of the stress, the author considers that all slabs of concrete in which metal is embedded below the neutral axis should not be fixed at the supports, but merely rest free on proper bearings. The units assumed in the preceding cases under review in this paper may be deemed to be over-cautious. Of course, the use of steel having now supplemented iron for such purposes, a unit stress of $6\frac{1}{2}$ tons per square inch may be taken. This, if anything, is, however, an additional argument in favour of the use of expanded metal, as the employment of other sections is seen to be in excess of requirements, whereas an expanded metal section gives sufficient but less sectional areas than in the other calculations. With an increased unit stress it is evident the moment of resistance contributed by the steel embedded in the section would bring down the neutral axis nearer to the level of the position of the centre of gravity, and hence under those considerations would increase the area available to resist compression. It will be observed that independently of facility of construction and uniform distribution of tensile resistance, the use of even a heavy section of expanded metal gives only 49 per cent. of the metal introduced with iron wires or bars, and about 20 per cent. of a tee-iron section.

Results of Experiments to Ascertain the Tensile Strength of the Following Pieces of Steel Made by Messrs. David Kirkaldy & Son for the Expanded Metal Company, Limited.

Test No.	Description.	Original Ultimate Stress.				Fractured.				Stress per sq. in. of fractured area.	Extension in 2 in.		Appearance of fracture.
		Size.	Area	Total	Per sq. in. of original areas.	Size.	Area	Difference area per cent.			In.	Per cent.	
		Inch.	sq. in	lbs.	lbs. tons.	inch.	sq. in			lbs.			
II.	Pieces 1 in. wide partially sheared longitudinally												
2547	Untreated portion. Piece 1 in. by $\frac{1}{16}$ in. sheared and one portion treated	shaped ·140 × ·200	·028	1677	39891 = 26·7	·090 × ·100	·009	·019	67·9	186333	0·55	27·5	Silky
2548	Treated or stretched portion (narrower)	·133 × ·191	·026	1849	71115 = 31·8	·093 × ·120	·009	·017	65·3	205444	0·17	8·5	Do.
2549	Untreated	·138 × ·200	·028	1771	63250 = 28·9	·090 × ·125	·011	·017	60·7	161000	0·41	20·5	Do.
	Do.												
2550	Treated	·137 × ·190	·026	1986	76384 = 34·1	·093 × ·130	·012	·014	53·8	165500	0·135	6·7	Do.
2551	Untreated	·140 × ·187	·026	1495	57500 = 25·7	·095 × ·082	·008	·018	69·2	186875	0·58	29·0	Do.
	Do.												
2552	Treated	·139 × ·174	·024	1656	69000 = 30·8	·100 × ·094	·009	·015	62·5	184000	0·15	7·5	Do.
	Mean of Untreated pieces.				60214 = 26·9				65·9			25·7	
	,, ,, treated pieces.				72166 = 32·9				60·5			7·6	

The following tests are useful for a comparison,—giving particulars of tests carried out by Messrs. Fowler & Baker upon experimental slabs for flooring purposes, with and without the use of expanded metal, the slabs being supported at their opposite ends :—

Reference Letter.	Date when made.	Size of Slab.	Clear Span of Slab.	Expanded Metal. Area and Mesh.	Expanded Metal. Strand.	Composition of Concrete (by Volume). Portland Cement.	Thames Ballast.	Unscreened Sand.	Water.	Date when Broken.	Age of Slab.
A	20/1/96	4′×2′×3″	3′ 1″	Made without expanded metal		3	0	1	1½	23/3/96	63 days.
B	20/1/96	4′×2′×3″	3′ 6″	Do.		3	0	1	1½	23/3/96	63 days.
C	30/1/96	4′×2′×3″	3′ 6″	Do.		3	0	0	1	17/4/96	77 days.
D	30/1/96	4′×2′×3″	3′ 6″	Do.		1	0	2	½	17/4/96	77 days.
E	30/1/96	4′×2′×3″	3′ 6″	Do.		1	0	1	½	17/4/96	77 days.
F	20/1/96	4′×2′×3″	3′ 6″	Do.		1	2	1	½	23/3/96	63 days.
G	17/1/96	4′×2′×3″	3′ 6″	4′×2′×3″ mesh	⅝″ × ⅛″	1	2	1	½	20/3/96	63 days.
H	30/1/96	4′×2′×3″	3′ 6″	4′×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	17/4/96	77 days.
I	20/1/96	7′×2′×3″	6′ 6″	None		3	0	1	1½	23/3/96	63 days.
J	20/1/96	7′×2′×3″	6′ 6″	None		3	0	1	1½	23/3/96	63 days.
K	20/1/96	7′×2′×3″	6′ 6″	None		1	2	1	½	23/3/96	63 days.
L	17/1/96	7′×2′×3″	6′ 6″	6′8″×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	20/3/96	63 days.
M	20/1/96	7′×2′×3″	6′ 6″	None		1	2	1	½	23/3/96	63 days.
N	1/1/96	7′×2′×3″	6′ 6″	6′8″×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	4/3/96	63 days.
O	30/1/96	7′×2′×3″	6′ 6″	6′8″×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	17/4/96	77 days.
P	30/1/96	7′×2′×3″	6′ 6″	6′8″×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	17/4/96	77 days.
Q	30/1/96	4′×2′×3″	3′ 6″	4′×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	17/4/96	77 days.
R	20/1/96	4′×2′×3″	3′ 6″	None		1	2	1	½	23/3/96	63 days.
S	1/1/96	4′×2′×3″	3′ 6″	4′×2′×3″ mesh	⅛″ × ⅛″	1	2	1	½	4/3/96	63 days.

Reference Letter.	Total Number of Rails required to break the Slabs.	Total Load (Uniform) to break the Slabs.	Deflections in Centre. At ¼ Breaking Load.	At ½ Breaking Load.	At ¾ Breaking Load.	Ultimate.	Breaking Load per Square Foot.	Remarks.
		Cwts.					Cwts.	
A	5	30	No appreciable deflection.				4·28	Broke in centre.
B	6	36	..	do.	..	..	5·14	Broke in centre.
C	3	18	..	do.	..	..	2·57	Carried weight of third rail one second.
D	2	12	..	do.	..	..	1·71	Carried second rail a few seconds.
E	3	18	..	do.	..	..	2·57	Carried third rail for one second.
F	3	18	..	do.	..	..	2·57	Broke in centre.
G	20	120	Nil	⅛″	⅛″	⅝″	17·14	Broke under one timber. The strands of expanded metal were not broken. The concrete sheared.
H	25	150	1/16″	⅛″	¼″	⅜″	21·43	Carried the twenty-fifth rail about half a minute.
I	3	18	..	do.	..	..	2·39	Broke under one timber.
J	3	18	..	do.	..	..	2·39	Broke in centre.
K	1	6	..	do.	..	..	0·46	Broke near centre after weight had been on for one minute.
L	11	66	1/16″	⅛″	⅛″	¼″	5·08	Broke under one timber. The strands of expanded metal were not broken through.
M	1	6	..	do.	..	..	0·46	Broke immediately weight was put on in centre.
N	10	60	Nil.	1/16″	⅛″	¼″	4·61	Broke in the centre. The strands of metal were broken through.
O	11	66	¼″	⅜″	½″	⅝″	5·07	Carried the eleventh rail about half-minute.
P	10	60	1/16″	1/16″	⅛″	¼″	4·61	Just carried the weight of tenth rail one second.
Q	23	138	⅛″	⅛″	¼″	⅜″	19·73	Carried the twenty-third rail about half-minute.
R	3	18	No appreciable deflection.				2·57	Broke immediately in centre.
S	14	84	1/16″	⅛″	¼″	⅜″	12·00	Broke under one timber. The strands of expanded metal were broken through.

Note.—The average weight of rails is taken at 6 cwt. each.

At 3 cwt. per foot super the test was adjourned for the day with a deflection of 1/16 in.

On May 24 the test was resumed, when the deflection was found to be 1¼ in.

At a load of 3½ cwt. a slight crack was observed on the under side of the slab, radiating from one corner towards the centre.

At 4 cwt. to the foot super there was a deflection of 1⅝ in.

At 4¾ cwt. the slab showed a crack across the centre in the direction of the longest span.

The slab was ultimately loaded to 5¼ cwt. to the foot super, and bore this load for 1½ hours when it collapsed, the fractures occurring at each of the four corners.

A Joint Committee of representatives of the Northern Architectural Association, the Newcastle, Gateshead, and Tyne District Master Builders' Association, and the Council of the Building Trades' Exchange appointed a sub-committee in 1899 to test the comparative breaking strengths of concrete slabs made with and without the addition of expanded metal. For this purpose twelve slabs were set up on wood centerings and brick piers in the foundry yard of the Gallowgate Iron Works belonging to Messrs. Henry Walker & Sons, Limited, on July 20 and 24, the centerings being removed on the following August 16. The concrete for the 5 in. slabs was specified to be composed of 4 parts clean washed gravel to pass a 2 in. gauge, 1 part of clean sand, and 1 of Portland cement. The concrete for the 3 in. slabs was specified to be composed of 2 parts clean washed gravel to 1 in. gauge, 1 of clean sand, and 1 of Portland cement. The cement used is stated in the Joint Committee's Report to have been procured from a merchant in the ordinary way. When tested there was no residue through a 50 sieve, and only 2 per cent. through a 70 sieve. It, however, only weighed 94 lbs. per striked bushel. The slabs, after they were cast in wooden boxes, remained exposed in the open to a continuous hot sun, which had "spider's webbed" the surface of the cement. All slabs were 4 ft. wide, so that the areas given are nett, the remaining width providing the wall support free at each end. The slabs were gradually weighted with pig-iron on September 19 and 20, 1899, the carefully recorded results being as follows, those containing metal being marked with an asterisk. The slabs were supported at their opposite edges.

Generally speaking there was reported to have been only slight deflection before breaking.

No. 1 broke before the test began, two men and six pigs of cast-iron being on it, *i.e.*, about 9 cwt.

No. 2 shows ¼ in. deflection under 75 cwt.; ½ in. deflection under 175 cwt., cracked at 220 cwt., and broke under a load of 237 cwt. 3 qr. 14 lbs.

No. 4 was unbroken under a load of 340 cwt. 1 qr. 21 lbs., when it was found inconvenient to pile the pig-iron to a greater height. It showed 1⅛ in. deflection, but returned to nearly its original straightness when this load was removed.

No. 5 broke accidentally while the men were piling up the weight upon No. 4 slab.

No. 9. The cracks on this slab were in form as sketched.

No. 10 was unbroken with a load of 270 cwt. 2 qr. 2 lbs., at which load the piling was 11 ft. high. Under a load of 261 cwt. 2 qr. 12 lbs. it indicated slight deflection but returned.

The co-efficients of expansion of the two constituents, iron or steel and concrete, are considered for all practical purposes to be identical. The expansion of steel at 500 deg. Fahr. is an inch in 28 ft., and at 1,000 deg. an inch in 14 ft.; when dull red-hot, iron is 1,300 deg. Fahr.

Cement adheres more firmly to iron and steel when left with its natural surface, and not treated by any anti-rust process. When surrounded with good concrete, while free from air, there is little fear that it will gradually corrode.

In some investigations made by the Engineer

In another test made by the Expanded Metal Company in May, 1900, upon a slab 12 ft. 6 in. by 11 ft. clear span, 5 in. thick, composed of 4 parts of fine clinker to 1 of Portland cement, with expanded metal embedded in the under surface, the expanded metal was 3 in. mesh, ½ in. by 1/16 in. strands, and was in four sheets, which were laid on the temporary centering with a 12 in. lap, and the meshes overlapping were clipped together with steel clips. After the concrete was set and the centering removed, the expanded metal was completely hidden in the under side of the concrete. The slab was allowed to remain for seven weeks, and was supported with a 3 in. bearing on its four sides on a timber sole plate. Thames ballast was thrown upon the slab in quantities of a cubic yard at a time, uniformly distributed until the load amounted to 35 tons, with slab supported on all four ends.

When the slab was loaded to 1 cwt. to the foot super there was no deflection.

At 1½ cwt. to the foot super there was ¼ in. deflection in the centre.

At 2 cwt. to the foot super there was ½ in. deflection.

At 2½ cwt. to the foot super ¾ in. deflection.

No.	Expanded Metal.	Nett Length.	Nett Area sq. feet.	Thickness in ins.	Concrete Proportions	Breaking Weight.	Remarks.
1	None.	8 ft.	28	8	5 to 1	9 cwt.	See note above.
2*	No. 10.	8 ft.	28	5	5 to 1	237 cwt. 3 qrs. 14 lbs.	See note above.
3	None.	6′ 6″	22	8	5 to 1	22 cwt. 2 qrs. 18 lbs.	Broke under this load.
4*	No. 10.	6′ 6″	22	5	5 to 1	Unbroken.	See note above.
5	None.	8 ft.	28	4½	3 to 1	Not recorded.	See note above.
6*	No. 8.	8 ft.	28	3	3 to 1	96 cwt. 1 qr. 17 lbs.	Broke under this load.
7	None.	5 ft.	16	8	5 to 1	124 cwt. 2 qrs. 20 lbs.	Broke under this load.
8*	No. 8.	5 ft.	16	3	3 to 1	213 cwt. 3 qrs. 8 lbs.	Broke under this load.
9	None.	5 ft.	16	4½	3 to 1	10 cwt. 3 qrs. 10 lbs.	Broke under this load. See also note above.
10*	No. 10	5 ft.	16	5	5 to 1	Unbroken.	See note above.
11	None.	6′ 6″	22	4½	3 to 1	17 cwt. 1 qr. 25 lbs.	Broke under this load.
12*	No. 8.	6′ 6″	22	3	3 to 1	113 cwt. 0 qr. 22 lbs.	Broke under this load.

of the St. Louis Merchants' Bridge Terminal Railway on the strength and adhesion of 2-in. diameter iron anchor bolts set 11½ in. in masonry with lead sulphur and cement, it was found that a rod provided with a screw thread to improve the grip of the cement began to yield under a test load of 32,000 lbs. and broke at a load of about 50,000 lbs. without developing the strength of the cement joint, while in the case of a rod left plain and smooth the cement began to yield at a load of 34,000 lbs., but did not entirely part, when the rock broke at a load of 67,000 lbs. *The Engineering and Building Record* of 1891 in reporting these experiments states that the larger blocks of stone could not be accommodated in the machine, but it was inferred that in a suitable setting the cement joint on a smooth rod might be made to break the rod. Professor Bauschinjer, of Munich, found that the adhesion of concrete to iron was about 569 lbs. to 668 lbs. per square inch, which, it will be noticed, is greater than the unit assumed for the concrete in this paper, and therefore the latter may, under favourable circumstances, be increased above an assumption of 400 lbs. per square inch. The use of twisted rods certainly offers a better grip than flat bars or wires. The finer a cement is ground the greater is its adhesive strength. In practice it will be found that the adhesion varies not only with the quality as well as the quantity of the cement, but also with the quality as well as the quantity of the sand, the porosity of the substances joined together, their degree of saturation and of course the length of time during which they have been joined. While the sand-carrying capacity of a cement bears a proportion to its adhesive capability, yet beyond the proportion of 2 to 1 sand detracts from the resistance more and more rapidly.

Particulars of Tests carried out by Messrs. Fowler & Baker upon Concrete Arches with a view to comparing with Flooring Slabs made with Concrete and Expanded Metal.

Number or Mark on Arch.	Date when Made.	Clear Span of Arch.	Width of Arch.	Thickness at Crown.	Rise of Arch.	Composition of Concrete.			
						Portland Cement.	Thames Ballast.	Unscreened Sand.	Water.
Arches.									
1	21/1/96	6′ 6″	3′ 0″	5″	5″	1	2	1	½
2	21/1/96	6′ 6″	3′ 0″	5″	5″	1	2	1	½
3	21/1/96	6′ 6″	3′ 0″	5″	5″	3	0	1	2½
4	21/1/96	3′ 6″	2′ 0″	3″	3″	1	2	1	½
5	21/1/96	3′ 6″	2′ 0″	3″	3″	1	2	1	½
6	21/1/96	3′ 6″	2′ 0″	3″	3″	3	0	1	1½

Number or Mark on Arch.	Date when Made.	Date when Broken.	Age of Arch.	Total Number of Rails required to Break the Arch.	Total Load (Uniform) to Break Arch.	Deflections in Centre.				Breaking Load per square foot.
						At ¼ Breaking Load.	At ½ Breaking Load.	At ¾ Breaking Load.	Ultimate.	
					Cwts.					Cwts.
1	21/1/96	23/3/96	62 days	14	84	—	¾ in.	1½ in.	2⅝ in.	4·31
2	21/1/96	24/3/96	63 days	—	—	—	—	—	—	—
3	21/1/96	24/3/96	63 days	10	60	⅛ in.	1⅛ in.	1⅞ in.	2½ in.	3·13
4	21/1/96	24/3/96	63 days	24	144	1/16 in.	⅛ in.	¼ in.	⅜ in.	20·57
5	21/1/96	25/3/96	64 days	28	168	1/16 in.	1/16 in.	1/16 in.	1⅛ in.	24·00
6	21/1/96	25/3/96	64 days	24	144	1/32 in.	⅛ in.	⅛ in.	1⅜ in.	20·57

Number or Mark on Arch.	Date when made.	Clear Span of Arch.	Width of Arch.	Remarks.
1	21/1/96	6′ 6″	3′ 0″	When the load was equal to 42 cwts.—half the ultimate load—a crack first appeared in the centre of the arch. This gradually increased until it was 1/16 in. wide on the underside before collapse.
2	21/1/96	6′ 6″	3′ 0″	Arch got damaged and could not be tested.
3	21/1/96	6′ 6″	3′ 0″	Cracked when quarter breaking load was on.
4	21/1/96	3′ 6″	2′ 0″	When five-sixths of the breaking load was on the work was left, and loading proceeded at 6.30 a.m. next day till the arch broke.
5	21/1/96	3′ 6″	2′ 0″	It broke suddenly.
6	21/1/96	3′ 6″	2′ 0″	Broke gradually.

Note.—The average weight of rails is taken at 6 cwts. each.

The spans may be considerably extended by the aid of the channel arch. The only objection is the exposure of the under surface of the channel metal rib, but this can be kept well painted for preservation, and as regards security the concrete will be, in time, able to do without it in the same way as cylinders filled with concrete for piers simply form a casing for the pier, the interior concrete itself forming the supporting column of the pier. The surface so exposed is very small, compared with the various systems of trough flooring that have been patented.

Channel irons, 6 in. by 2 in. (12 lbs.), 5 ft. centres, have been successfully used in 16 ft. span arches and 4 ft. centres for 20 ft. 6 in. spans, with Portland cement 4½ in. clinker concrete, 4 to 1, and No. 10 expanded metal. After placing the centering in position and filling the haunches the expanded metal is laid down horizontally, the sheets being placed lengthwise across the beam, and overlapped at the sides and ends. The concrete is then finished off to the required level while the under concrete is still green, so that the whole arch forms one homogeneous section, leaving a level top with a smooth under surface when the centering is taken away. It may be remarked that the presence of the transverse channel metal arch, firmly held between the longitudinal joists, enables the centering to be removed at an earlier stage than otherwise; but it is prudent not to strike the centreing for at least ten days.

Mr. A. Baker, of the Beckton Gasworks, conducted an experiment with a concrete and expanded metal structure, under the instructions of Mr. G. C. Trewby, M.Inst.C.E., consulting engineer to the Gas Light and Coke Company, in which the concrete consisted of ordinary Thames ballast, passed through a ¾-in. sieve, and Portland cement (of 112 lbs. per bushel 10 per cent. residue on 2,500 mesh sieve, 450 lbs. tensile strength, after twenty-eight days' immersion) in the proportion of one of cement to four of ballast. The expanded metal was introduced in sheets 17 ft. by 5 ft. 6 in. wide, 3 in. mesh, ¼ in. by 1/16 in. strands. The structure consisted of a 6 in. slab of concrete, 17 ft. clear span by 10 ft. wide, supported for 1 in., the foundation being formed of ordinary railway sleepers laid crosswise on the firmest ground that could be found upon the site. After setting thirty-four days the trial weight in the form of rails (56 lbs. per yard) was gradually applied. These rails were laid on top of a course of blue Staffordshire bricks to ensure an evenly distributed load. With a load of 27 tons a slight crack was observed running diagonally through the concrete of No. 1 arch about 6 ft. from the north abutment, and a similar flaw was noticed in No. 3 arch in about the same position when 38 tons had been applied. But as these did not widen out or extend in any way during the remainder of the test, very little importance was attached to them, as they were considered to have been caused by a slight spreading out of the abutments. At this point the average deflection of the three channels was 3/16 in. A certain number of rails were added each day until 100 tons (equivalent to 11·8 cwt. per superficial foot) was equally distributed over the slab; but this did not seem to have any appreciable effect on the structure, the deflection of the channel irons being 1 in., and of the concrete slab barely ½ in. In places the channel irons parted a little from the concrete, but not more than ⅛ in. In Mr. Baker's report he states that, after letting this weight remain for three weeks, an additional 26 tons were added, the result being a slightly increased deflection. Soon after commencing to load the next morning it was seen that one corner of the foundation was sinking, throwing the weight over on that side. No. 3 channel iron showed signs of buckling close to the foot, and the concrete in the three arches began to disintegrate by the abutment. The total weight evenly distributed over the structure was 128 tons 5 cwt., equal to 15·09 cwt. per square foot. The slab was carefully examined at this stage and found to be intact, with a deflection in the centre of ½ in. The average deflection of the channel irons was 1 3/16 in., all three keeping their shape very well with the full load on.

Area of slab ..... 170 square feet.
Structure finished ... November 2, 1899.
Commenced loading December 4, 1899.

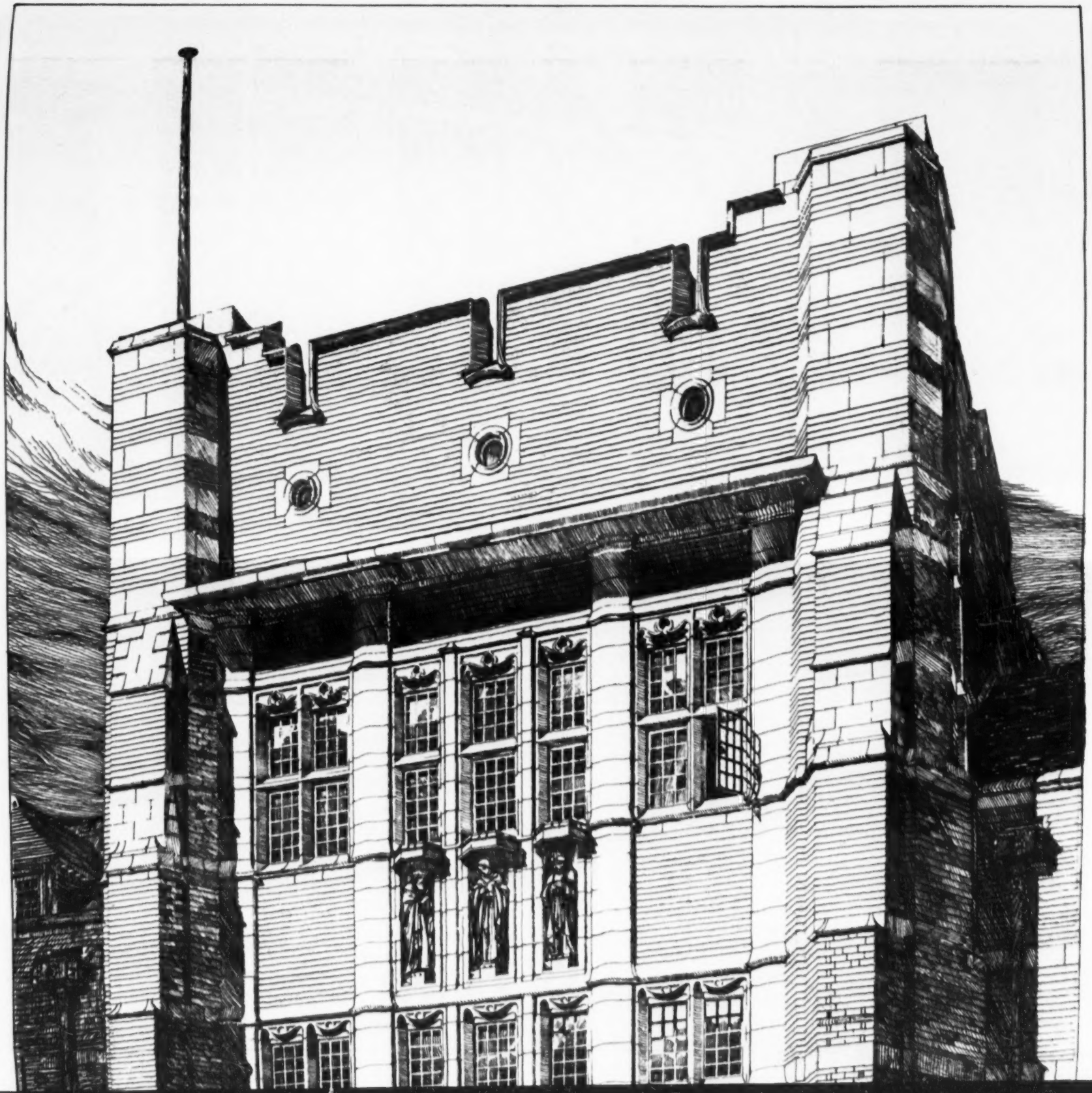
Date.		Weight on.				Average Deflection	Load per sq. ft.
		tons.	cwts.	qrs.	lbs.	ins.	cwt.
1899							
December	5	14	17	1	22	—	1·75
,,	6	27	10	3	22	1/16	3·84
,,	7	38	2	0	22	⅛	4·43
,,	8	46	11	0	22	3/16	5·48
,,	12	54	14	0	22	5/16	6·44
,,	13	62	17	0	22	7/16	7·40
,,	14	71	0	0	22	½	8·35
,,	15	79	3	0	22	9/16	9·30
,,	16	87	6	0	22	⅝	10·27
,,	18	91	7	2	22	¾	10·75
,,	19	99	15	0	0	13/16	11·74
,,	20	99	15	0	0	⅞	11·74
1900							
January	16	126	9	3	0	1⅛	14·88
,,	17	128	5	3	0	1⅛	15·09

It may be of interest to hear that expanded metal has been used in many of the new buildings at Beckton with satisfactory results.

The cost of the use of expanded metal depends in no small degree upon the extent of the work. The makers prefer to include the concrete in their contract when they are expected to undertake responsibility for the stability of a structure involving the use of expanded metal. The saving, however, is mainly in weight and head room, although, as hinted in this paper, there may be cases where a tubular top might be advantageously introduced, whereby strength would be attained without increased weight, though at the expense of reduction in headway.

The fact that the introduction of metal into concrete as a tensile element is advantageous is generally accepted, and the author trusts that his paper may elicit a discussion upon the subject suggestive of desirable improvements (if any) in the size of the meshes which are formed in the metal or of further experiments needed in the application of expanded metal to concrete structures. Hitherto it has been chiefly used in cases where the steel work for floor construction has been already designed. The best and most economical results would be obtained by a disposition of framework calculated to suit the carrying-power of the concrete with the aid of expanded metal whereby the user could employ concrete of a wider span than when employing plain concrete.

THE BUILDER. SEPTEMBER 15, 1900.



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Weight on.				Average Deflection	Load per sq. ft.
tons.	cwts.	qrs.	lbs.	ins.	cwt.
14	17	1	22	—	1·75
27	10	3	22	$\frac{1}{8}$	3·24
38	7	0	22	$\frac{1}{4}$	4·48
46	11	0	22	$\frac{3}{8}$	5·48
54	14	0	22	$\frac{7}{16}$	6·44
62	17	0	22	$\frac{1}{2}$	7·40
71	0	0	22	$\frac{5}{8}$	8·35
79	3	0	22	$\frac{11}{16}$	9·30
87	6	0	22	$\frac{3}{4}$	10·27
91	7	2	22	$\frac{13}{16}$	10·75
99	15	0	0	$1\frac{1}{16}$	11·74
99	15	0	0	$1\frac{1}{8}$	11·74
126	9	3	0	$1\frac{5}{8}$	14·88
128	5	3	0	$1\frac{11}{16}$	15·09

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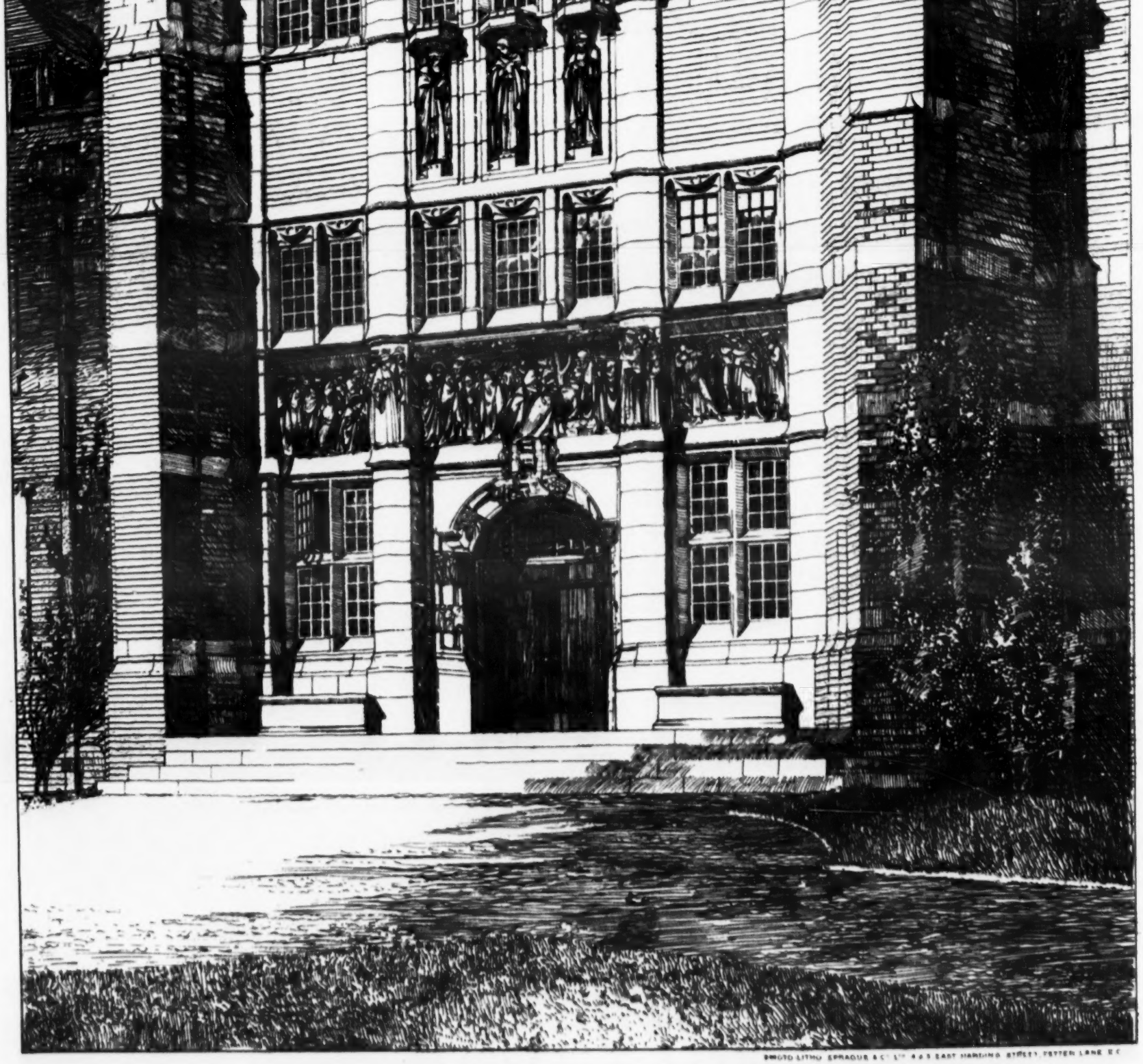
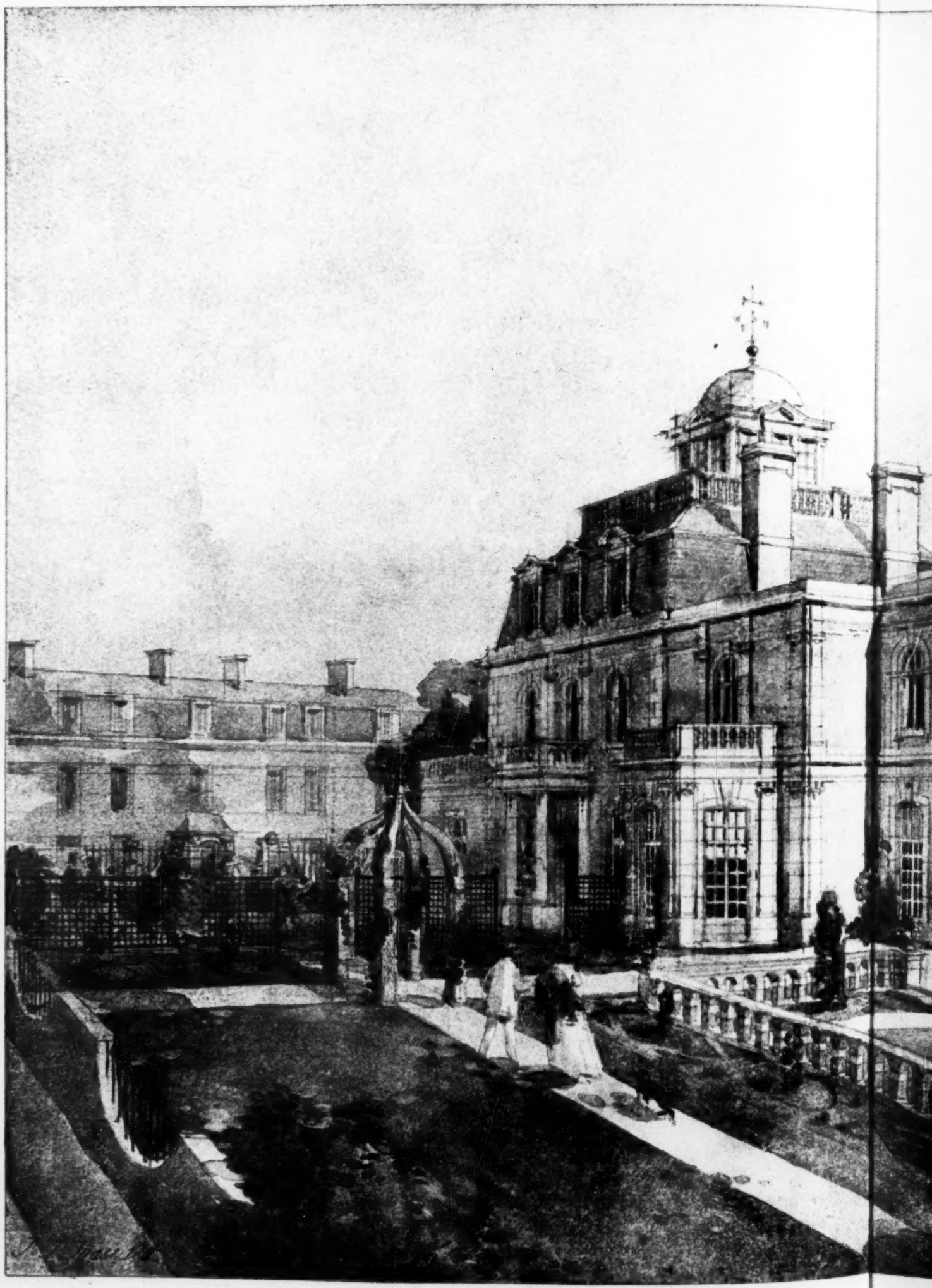
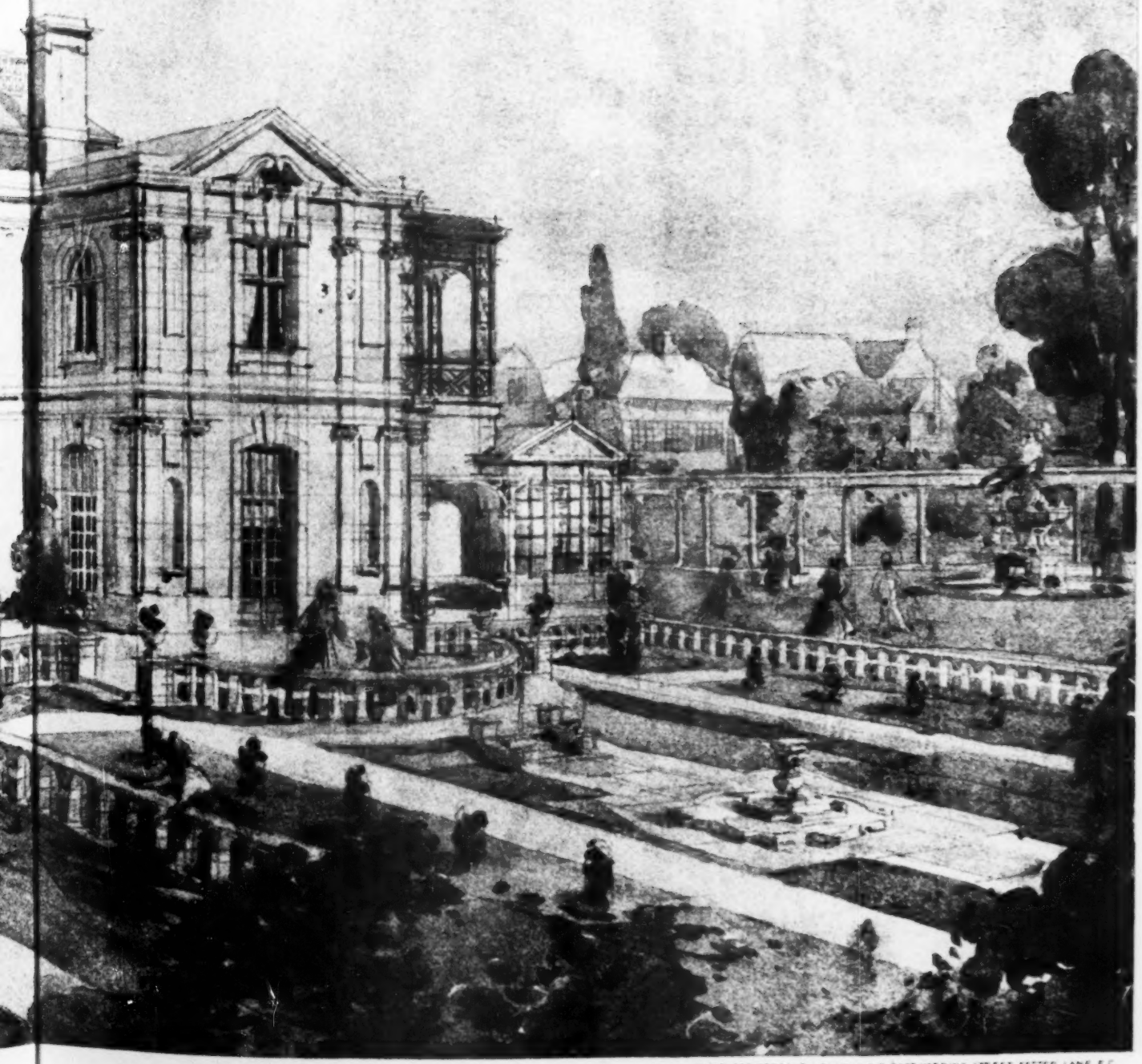


ENTRANCE TOWER, THE CHAPEL, ALL SAINTS' CONVENT, ST. ALBANS.—Mr. Leonard Stokes, F.R.I.B.A., Architect.



Château Mauricien
Mimereux
John Belcher A.R.A.
Architect



INK PHOTO ERASURE & C° L^D 4 & 5 EAST HARDING STREET FETTER LANE E.C.

COMPETITIVE : DESIGN :
FOR : CENTRAL : LIBRARY :
KINGSTON : UPON : HULL :
J.F. DUTHOIT A.R.I.B.A. Archt. DOVER :

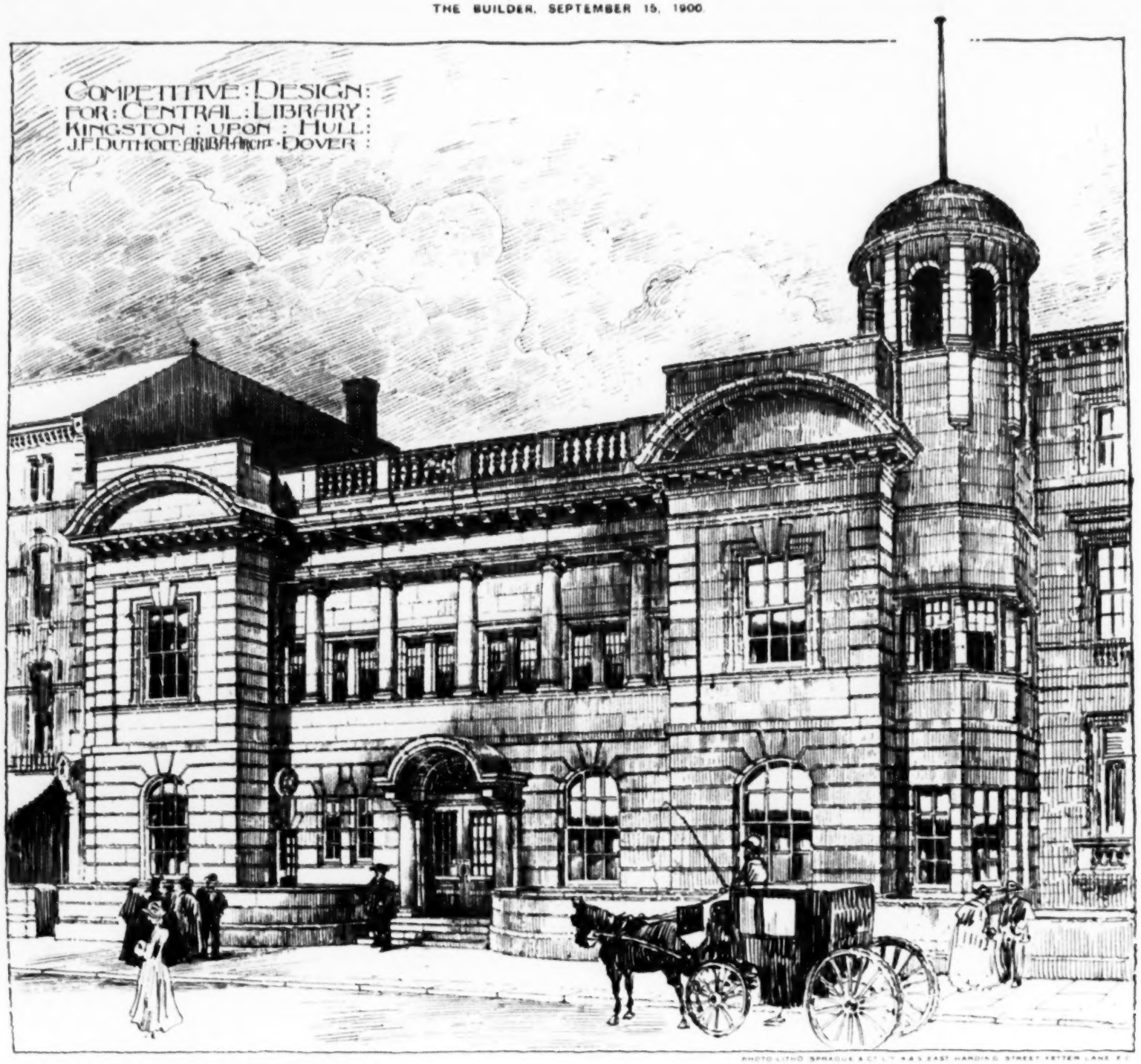


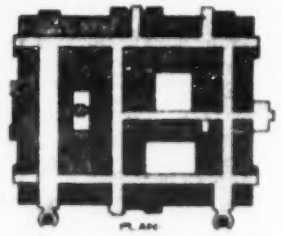
PHOTO-LITHO SPRAGUE & C° LT 4 & 5 EAST HARDING STREET FETTER LANE E.C.

THE GRANGE, TOTTERIDGE.—Mr. C. A. Nicholson, Architect.

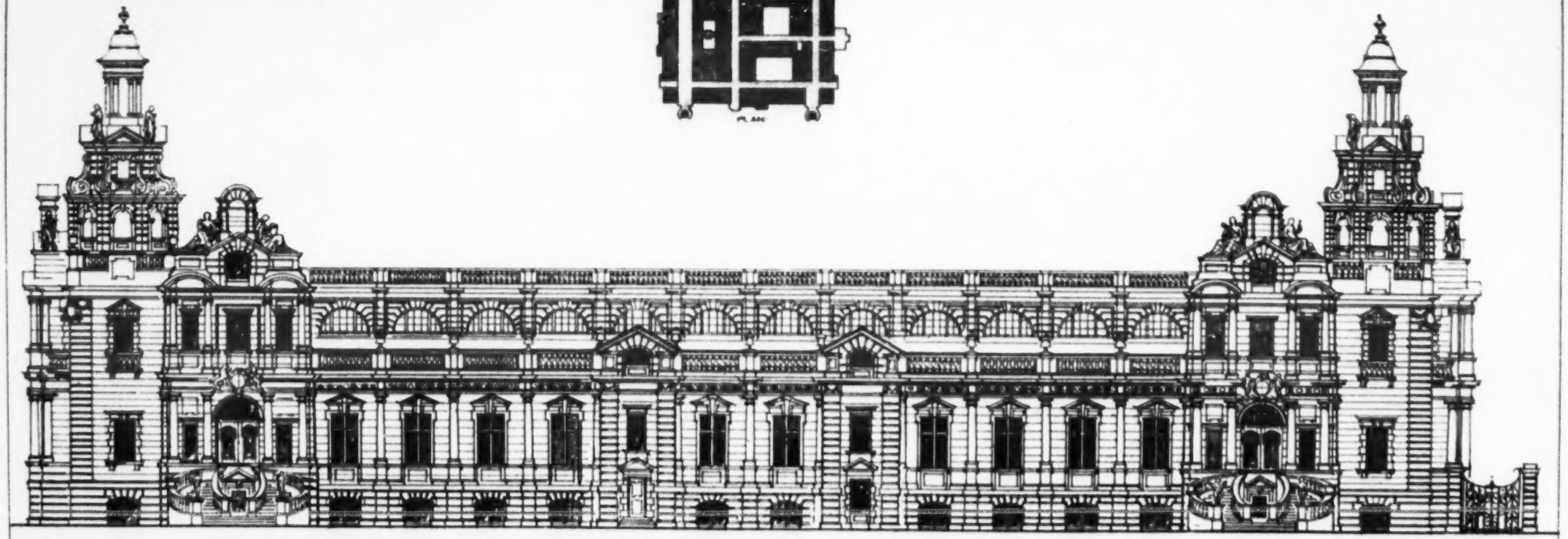
INK PHOTO SPRAGUE & CO LTD 4 & 5 EAST HARDING STREET FETTER LANE E C

DESIGN FOR REFITTING MISSION CHURCH AT WALWORTH. MR C. A. NICHOLSON, ARCHITECT

· COMPETITIVE · DESIGN · FOR · CARDIFF · LAW · COURTS · · ·



PLAN.



SCALE OF 0 1 2 3 4 5 6 7 FEET

NORTH-EAST ELEVATION

WM. PITE & R.D. BRUNTON, } ARCHITECTS.

PHOTO-LITHO SPRIGGS & CO. LTD. 43 & 45 EAST HARDING STREET, FETTER LANE, E.C.

The stock sizes of expanded metal are as follows :—

Size of Mesh.	Strands.	Size of Mesh.	Strands.
6"	½" × ½" bare.	½"	⅛" × 20 G bare.
6"	⅛" × ½" "	½"	⅛" × 18 G "
6"	¼" × ½" "	¾"	⅛" × 16 G "
6"	¼" × ¾" "	¾"	¼" × 16 G "
		¾"	¼" × ½" "
3"	½" × ½" "	⅝"	⅛" × 16 G "
3"	¼" × 16 G "	⅝"	⅛" × 18 G "
3"	⅛" × ½" "	⅝"	⅛" × 20 G "
3"	⅛" × ⅜" "		
3"	⅛" × ½" "	½"	⅛" × 16 G "
3"	¼" × ½" "	½"	⅛" × 18 G "
		½"	⅛" × 20 G "
1½"	⅛" × 18 G "		
1½"	¼" × 16 G "		
1½"	⅛" × 16 G "		
1½"	¼" × ½" "		
1½"	⅛" × ½" "		
1½"	¼" × ½" "		

Illustrations.

COLNEY CONVENT.

OUR illustration showing the Tower Entrance to All Saints' Convent, Colney Chapel, St. Albans, is in reality a detail of a portion of the main front of this building, a bird's-eye view of which we published on February 3, 1900. We gave a general description of the building at the time, and it is only now necessary to say that the works are rapidly approaching completion. Mr. H. Wilson has undertaken to model the groups of sculpture, &c., shown in the illustration.

As before stated, this convent is for the sisters, whose head house is now in Margaret-street, Cavendish-square. Messrs. Wm. King & Sons, of Westminster, are the builders, and Mr. Leonard Stokes is the architect.

CHÂTEAU MAURICIEN, WIMEREUX.

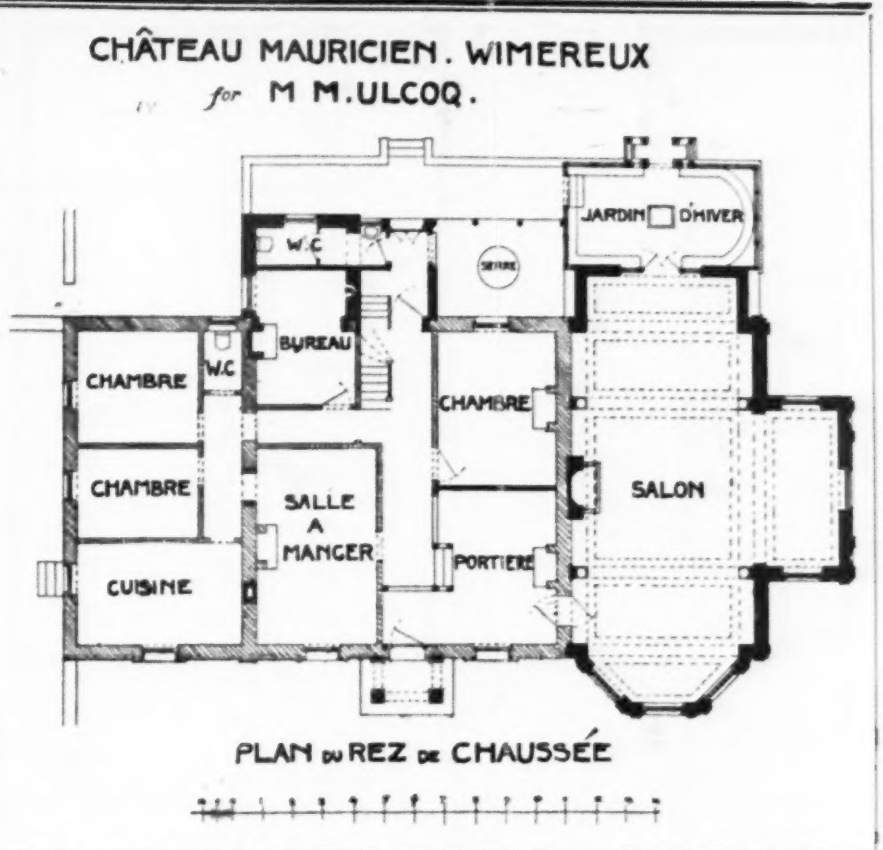
THE view represents part of the additions to the Château Mauricien. The house has been practically rebuilt in the "Empire" manner, to which period the original building belonged. The blacked-in parts on plan show new work and the hatched parts old.

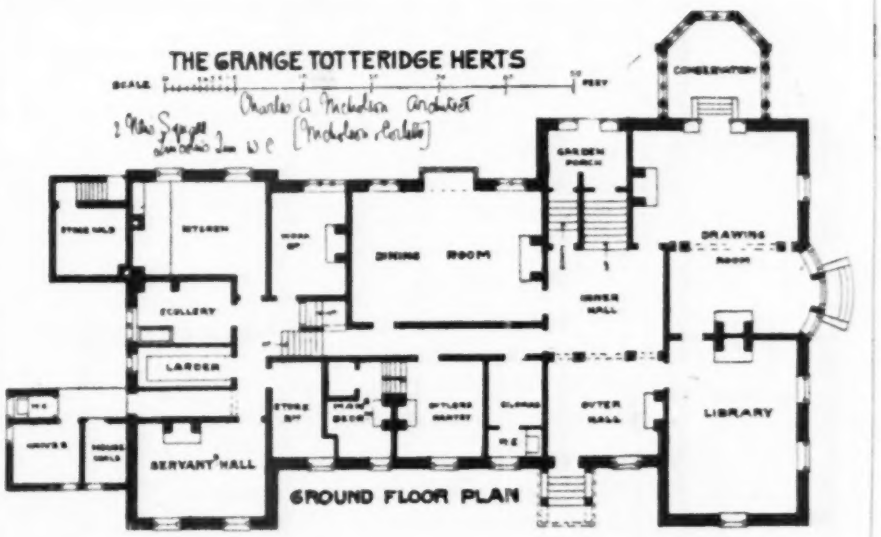
The whole of the work has been carried out by local workmen, with satisfactory results, from the drawings and full-sized details supplied to them. The interest displayed by them in the decorative details, the trellis-work, the garden buildings and accessories was such as may be looked for in vain from the British workman. JOHN BELCHER.

THE GRANGE, TOTTERIDGE, HERTS.

THE old Grange was destroyed by fire in 1899; but the brick vaults of the cellars preserved the foundations of the earliest portion of the house, and these naturally suggested some of the lines of the new work which has recently been completed. But otherwise little trace of the old plan remains, except that the dining-room occupies much the same position as it did formerly.

The greater part of the present south front, the east wall of the drawing-room, the east and north walls of the principal staircase, the north and west walls of the entrance-hall, and the walls separating the drawing-room from the library, and from the staircase and hall, indicate generally the positions of the old foundations. The front entrance and covered porch has been placed on the west, not on the south, as it was before. By this arrangement the new plan provides a hall 30 ft. by 17 ft., from which the principal rooms are approached. On the left lies the dining-room, which is 28 ft. by 19 ft.; and on the opposite side is, first, the library, 25 ft. by 19 ft.; and next the drawing-room. The latter is one large room separated into two parts by some pilasters and piers, which support a girder carrying a wall above. The length of this room from east to west is 30 ft., with a mean width of 21 ft. But either portion alone would be large enough for ordinary purposes as a separate room. The larger section is 24 ft. by 16 ft., and the other 19 ft. by 13 ft. With this idea in view allowance has been made for connecting the latter both with the hall and the library if necessary.





The kitchen, servants' hall, and offices being necessarily on a lower level than the reception rooms, made it possible to introduce a mezzanine floor, an arrangement which, in this case, is convenient since it provides for the maid-servants' bedrooms on a level between the ground and first floors, instead of on a second floor, or in the roof. Connected with the butler's pantry are separate bedrooms for two men-servants. One of these is on the basement level, the other in the mezzanine.

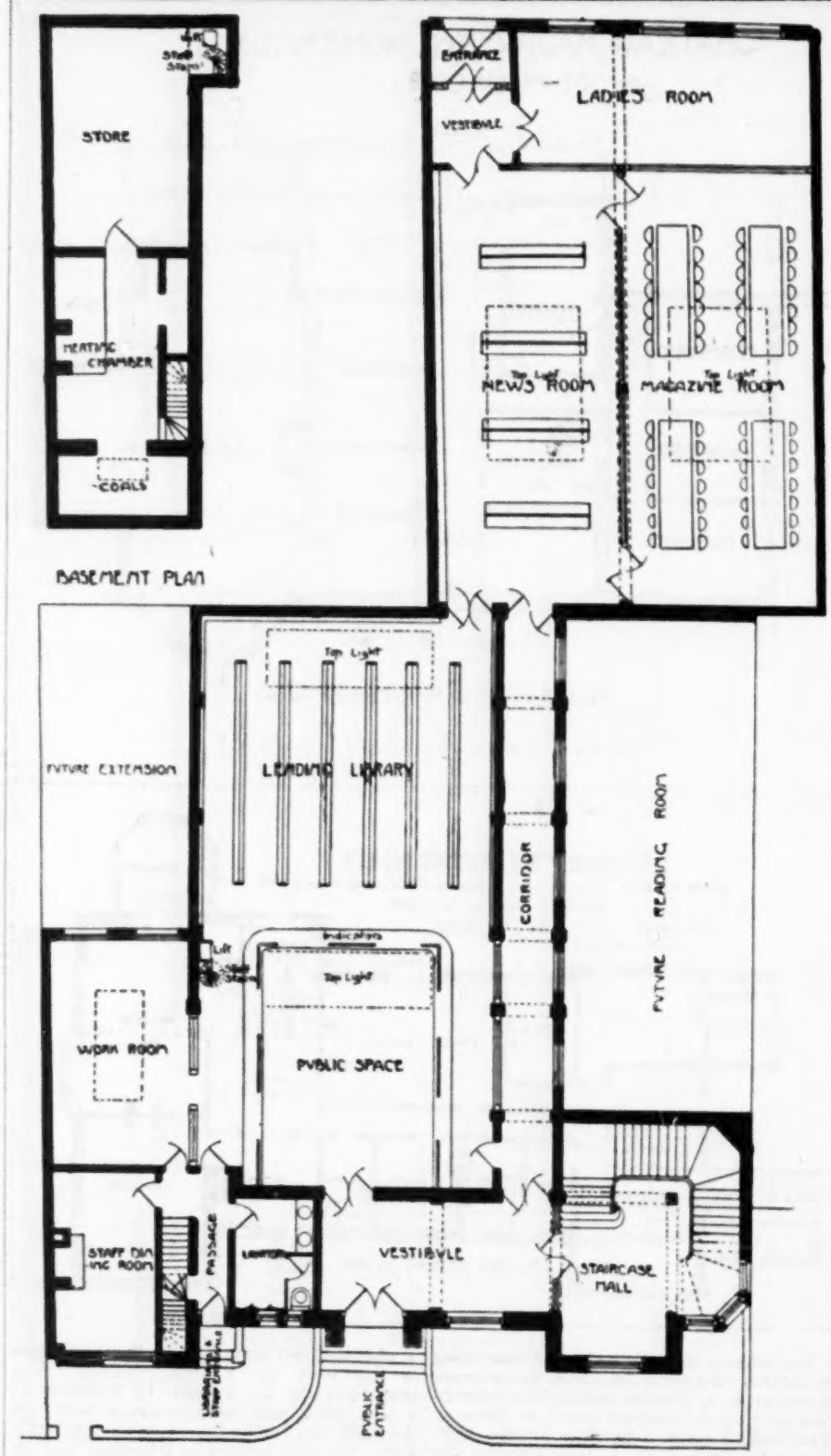
The upper hall is lighted from the ceiling, as well as by the large window on the main staircase, and from it there is access to the studio (24 ft. by 16 ft.), and the writing-room, as well as some of the bedroom suites. A corridor leads out of it to the bachelors' quarters and smoking-room, which are over the mezzanine. The dining-room table and sideboards were made by Mr. H. Read, of St. Sidwells, Exeter; and the carved mantelpieces by Mr. H. K. Kuchemann, of Pitsea, Essex, from the architect's designs. Messrs. Maides & Harper, of Croydon, were the builders.

WALWORTH MISSION CHAPEL.

IT had been proposed that the chancel of this chapel should be slightly remodelled and the whole of the interior decorated. The drawing shows one suggestion that was made in order to indicate the way in which a little room could be provided for a chancel and choir. This was done by placing a screen on a platform two steps higher than the nave to the west of a small chancel. The latter was to be formed by building up a 9-in. brick wall, with a clergy vestry on the north, and one for the choir on the south. Aoove the choir vestry was the organ with its loft over the sedilia. These were made to be part of a simple scheme of decoration in conjunction with a new altar, reredos, and dossal. The brick walling of the vestries being carried over from the north to the south by an arch gave an opportunity for using the whole of this walling as a ground for plaster to which some bright and fresh colour could be applied. Over the chancel and a little above the arch was a wooden ceiling decorated in white and green with a little black. The main roof of the building was only to be cleaned and painted so as to destroy the heavy and depressing colour of its varnish.

COMPETITIVE DESIGN FOR CENTRAL LIBRARY, KINGSTON-UPON-HULL.

THIS building was designed to comprise in the basement a book store, heating chamber and coal store, with a staff circular staircase and book lift leading right up to the gallery of the reference book store; and upon the ground floor a lending library with the space for the public immediately opposite the main central entrance, with the staff dining-room, work room, librarian's entrance and staircase, and staff lavatories on the one side, and the public



Design for Central Library, Kingston-upon-Hull. Plan.

staircase on the other side, with a corridor leading to the news and magazine room, and ladies' room, and entrance from Baker-street. On the first floor a reference library with a book gallery round the walls at half its height, under which are placed book cases at right angles to the wall, book store and librarian's room.

It was proposed that it should be built of brick with stone facings, slate roof, the floor generally to be fireproof laid with wood block, except the vestibules and corridors, which were to be laid with mosaic, and staircases of patent stone.

JOHN F. DUTHOIT.

DESIGN FOR CARDIFF LAW COURTS.

THIS illustration is the north-east elevation of the design submitted by Messrs. W. A. Pite and R. S. Balfour in the competition for Cardiff Law Courts. As the authors are out of town, we are not able to give any particulars of their design.

INTERNATIONAL CONGRESS ON THE TEACHING OF DRAWING, PARIS.

THE first "International Congress on the Teaching of Drawing" was held in Paris at the Cercle de la Librairie, from August 29 to September 1, and proved one of the most interesting congresses that have been held in Paris during the Exhibition. The Committee of Organisation was as follows:—President, M. Paul Colin, Inspecteur Principal de l'Enseignement du Dessin et des Musées, Professeur à l'École Polytechnique, &c.; President of the First Section, "General," M. Jules Jean Pillet, Inspecteur Honoraire de l'Enseignement du Dessin et des Musées, Professeur à l'École Nationale des Beaux Arts et au Conservatoire Nationale des Arts et des Métiers, &c.; President of the Second Section, "Technical," M. Paul Jacquemart, Ingénieur Civil des Mines, Inspecteur Général des Écoles d'Arts et Métiers et de l'Enseignement Technique au Ministère du Commerce et de l'Industrie; President of the Third Section, "Special," M. Louis Guébin, Inspecteur Principal de l'Enseignement du Dessin dans les Écoles de la Ville de Paris. General Secretary, Mme. Luisa Chatrousse, artiste peintre, professeur de dessin dans les écoles de la ville de Paris, Vice-Présidente de l'Association des Professeurs de Dessin de la Ville de Paris.

The Congress was opened on August 29 by Monsieur Leygues, Minister of Public Instruction, who touched upon the many advantages which might be derived from a general discussion on the various methods employed in the different countries for the teaching of drawing, and the important place that drawing should take in general education. In his opinion no education was complete without it, and consequently he considered drawing should be made an obligatory subject.

Details were discussed in separate sections, and the resolutions proposed were afterwards brought before a full meeting of the members of the Congress to be finally adopted and passed. The main points of the discussion were as follows:—

Drawing to be made a compulsory subject.

That the initiative of the teacher and the individuality of the student should be encouraged as much as possible.

That the artist and the workman should be brought nearer together by the former giving more attention to the exigencies of the trade or craft for which he designs, and that for the latter a more liberal art education should be provided.

The want of a more scientific training for the architect and a more artistic training for the engineer was also very fully discussed, and it was considered most desirable that the two should work in closer contact with each other.

Two mornings of the Congress were devoted to visiting the Educational Art Sections of the Exhibition under the guidance of MM. Guébin, J. J. Pillet, and Francken, and the explanations given by these gentlemen on their own sections proved most instructive.

At the close of the proceedings it was proposed by M. Germon, the Swiss delegate, that a permanent International Committee should be formed with the view to continue the work of the present Congress, and for the organisation of others in the future.

The proceedings were brought to a close by an address by the Minister of Fine Arts, who congratulated the Congress on the admirable resolutions passed, and said that he should do all in his official capacity to assist in having them carried out.

On the first evening of the Congress the members were entertained by the "Association Amicale des Professeurs de Dessin," of which M. Ed. Valton is President, and on the last afternoon they were received by the Mayor at the Hotel de Ville, when the reception-rooms were lighted up for the occasion. A banquet in the evening at the Exhibition terminated the social functions. Before separating, hearty votes of thanks were proposed by the representatives of the various nationalities to the Commission of Organisation for the thorough way in which the proceedings of the Congress had been carried out, and for the cordial welcome that had been extended to all.

COMPETITIONS.

JOINT ISOLATION HOSPITAL SCHEME, DEVIZES.—At a meeting of the committee appointed to carry out the erection of a joint isolation hospital for the combined urban and rural districts, the clerk, Mr. O. Sheppard, reported that in response to an advertisement he had received applications for particulars from 104 architects who were desirous of submitting sets of plans in competition for the premiums of 20*l.* and 10*l.* respectively. It was resolved to appoint Mr. C. E. Ponting, F.S.A., as professional assessor to advise the committee as to the selection of the plans, &c. It was resolved to inform the competitors that the committee would lay gas and water mains to the proposed site for the hospital.

TECHNICAL INSTITUTE, PORTSMOUTH.—The following are the chief points from the instructions to architects in the competition for a new Technical Institute at Portsmouth:—1. The

competition is confined to local architects. 2. The total cost must not exceed 43,000*l.* 3. Gothic designs will not be considered suitable. 4. The author of the first premiated design will receive 100*l.*, of the second 75*l.*, and the next 50*l.* 5. If the first premium plan is used the premium will be merged in the commission. Mr. Alfred Cross, F.R.I.B.A., will assist the Committee in determining the merits of the several designs.

ARCHÆOLOGICAL SOCIETIES.

EAST RIDING ANTIQUARIAN SOCIETY.—The members of the East Riding Antiquarian Society recently visited Pocklington and Warter. The party assembled at Pocklington Church at two, and, after examining its exterior, had its history briefly narrated by Dr. Leadman, of Pocklington. Dr. A. Lex Leadman, F.S.A., explained from his book on the church and school that Christianity made its way into those parts about A.D. 627, and the first church was a wooden structure. About 1070 or 1080 the stone edifice replaced this in the Norman style. Of that fabric there were still some remnants in the north pier of the chancel, and in a few carved stones built in the porch. About the end of the twelfth century, or early in the thirteenth, the north aisle was added, of which remains the arcade with its remarkable and beautifully-carved capitals. Fifty years later saw the addition of a southern aisle, of which both the arcade and centre wall still existed. The chapel was added on the north side of the chancel in the thirteenth century, and then there seems to have been a pause in the building for about 100 years. Then the chancel was rebuilt, the clearstory put in, the grand tower added, and new roofs to all parts of the church. The tracery and the stained glass were modern. The style of the present building is Perpendicular, and its most striking feature is the tower. The font is old, and worth notice. Its basin, of eleventh century work, is cut into a single square piece of fossil limestone. On the north wall is a tablet in white marble in memory of the Sotherby family. Against the south wall of the chancel is a fine monument to the memory of Robert Denison, of Kilnwick Percy, over which is a fine series of elaborate carvings, supposed to be the work of Albert Durer, and brought from Italy. The registers, which dated as far back as 1559, contained several interesting entries, including the coronation of James I., the execution of two witches by burning in the market-place, charges of being witches, and accounts of various plagues.—Afterwards the party proceeded in carriages to Warter Priory. The Rev. M. C. F. Morris, F.S.A., in describing the excavations at Warter, said that in September last he and Mr. W. H. St. John Hope carried out the excavations on the site of the Priory, which had been kindly placed at their service by Mr. C. H. Wilson, M.P., who also undertook to defray all expenses. In 1132 a priory of Black Canons was founded at Warter by Jeffrey Pain, and in the time of Henry VIII. the clear annual income of the Priory was given as 144*l.* 7*s.* 8*d.* In 1536 the Priory was suppressed, and its site and possessions granted to Thomas, Earl of Rutland, a descendant of the founder. The excavations were made on a level plateau on the north and east of the parish church. The latter was a wholly modern structure, but appeared to stand on the site of the old church which was destroyed in 1864. Trenches were cut through the more prominent mounds, but the results were disappointing, for although occasional fragments of ashlar and stonework were turned up, the mounds themselves contained nothing but rubbish. It was evident that the nave of the Priory had served as the parish church. In places the foundations had been utterly destroyed. Although the efforts to trace the walls had such unsatisfactory results the excavations yielded finds of a more interesting character. In tracing the pavement it was possible to ascertain the position of the steps up to the altar. The altar had originally been of some architectural pretensions, but at the end of the thirteenth century had become old-fashioned, and a new block of chalk was built upon the old plinth. The length was extended to 15 ft., which was the only extensive extension he had met with. A stone coffin was discovered in front of the altar. It had lost its lid, and had been much broken by the fall of heavy material. The contents had been disturbed, and only a few bones were left. A grave slab was also discovered. It had been cracked across by fallen material, but was otherwise complete, and was in admirable preservation. The slab was of fine sandstone, and measured 6 ft. 9½ in. by 3 ft. 2½ in. in breadth, with a thickness of 7 in. It bore the incised effigy of a Black Canon beneath a crocketed canopy, with an inscription containing the name of Thomas Brydlington, who was the twenty-fifth Prior of Warter in 1495. The excavations were not very extensive, nor did they lead to anything of much importance beyond establishing the site of the Priory. But as the result of one week's work with from only five to eight labourers the results could not be called unsatisfactory. At any rate, they produced three unusual features. There was a marked absence of architectural and, indeed, of any other fragments or details, so thoroughly had the place been destroyed and spoiled.—*Hull News.*

Correspondence.

To the Editor of THE BUILDER.

RE SOUND-PROOF FLOORS.

SIR,—I am much obliged for your answer to my query respecting above.

Would you please say if nailing to the undersides of joists fibrous slabs, which are claimed to be "non-conductive," would dispense with the pugging suggested? ARGUS.

*** Fibrous plaster slabs are fairly, but not perfectly, "non-conductive" of sound, and the pugging would be a valuable addition.—ED.

The Student's Column.

LESSONS IN ELECTRICAL ENGINEERING.

10. POLYPHASE CURRENTS—POWER TRANSMISSION SCHEMES.

THERE is no more interesting recent development of electrical engineering than the theory and practice of polyphase currents. A few years ago polyphase currents were looked upon by British engineers as something quite remote from practical work, and, although they were aware that this system was gradually coming into favour abroad, yet they were unwilling to add another to the great variety of systems in use in this country. Even now as a rule they only adopt it in a half-hearted manner. In the Central London Railway and in the Dublin Tramway system, for example, we have three phase generators, but then the three-phase currents are converted into continuous before they get to the motor terminals. Some of the London supply companies produce at their power stations two-phase currents, but then they supply their consumers with single phase currents. On the Continent and in America, however, they have recently constructed systems in which polyphase currents are used throughout both for lighting and power purposes.

The Burgdorf-Thun full-gauge railway in Switzerland is worked by three-phase currents. So also are the steep mountain railways of Engelberg, of the Gornergrat, and of the Jungfrau. In the North of Italy a full-gauge railway 110 miles long will shortly be run on the three-phase system. Converter stations will be placed at intervals of 6½ miles, and the current, which will be generated at 20,000 volts, will be converted down to 3,000 volts, and at this pressure the motors in the trains will be worked. Such examples could be multiplied indefinitely, as quite three-fourths of the new electric supply stations building outside Britain are on the polyphase system.

In a two-phase system we have four mains carrying currents which are all out of step with one another. For example, when the current in No. 1 main has its maximum positive value, the current in No. 2 main will be zero. In No. 3 main it will have its maximum negative value, and in No. 4 main it will be zero. The currents in adjacent mains are out of step by a quarter of a period. No. 1 and No. 3 main are out of step by half a period, hence if they be joined together at the far end we get a simple alternating current circuit, the current going by No. 1 and returning by No. 3 or *vice versa*. Similarly No. 2 and No. 4 would form a simple alternating current circuit. Hence if we have two alternating current circuits, the currents in which differ from one another by a quarter of a period, we get a two-phase system. If the two armatures of two alternators be rigidly connected, and have such a relative angular position to one another that when the E.M.F. between the collecting rings of one alternator is a maximum, the E.M.F. between those of the other is zero, then if we have four mains connected to the brushes pressing on the four collecting rings we obtain a two-phase system. If the pressure between No. 1 and No. 2 connected to the first alternator be V volts, then the pressure between No. 1 and No. 4 or No. 2 and No. 3 is also V. The pressures between No. 1 and No. 3 and between No. 2 and No. 4 are, however, $\sqrt{2}$ V, *i.e.*, 1·414V.

It will be obvious from the diagram we gave in Lesson 9 of the method of obtaining a rotating magnetic field by means of alternating current magnets how easy it is to obtain this kind of field when two-phase mains are available. We have simply to connect the windings of the magnets successively to the four mains, and we get a powerful rotating, or, as it is more often called, rotary field. A squirrel-cage armature placed in this field will rotate with great velocity, and the slower it goes as the load is increased the more powerful will be the torque. The maximum torque is at starting just when it is most wanted. In large motors, to prevent the great rush of current at the start, resistance is introduced into the rotor windings by having these windings connected to two slip rings, and joining these rings by the brushes pressing on them to the terminals of the required resistance.

There are two ways of connecting up the mains of a two-phase system. In fig. 1 let A,

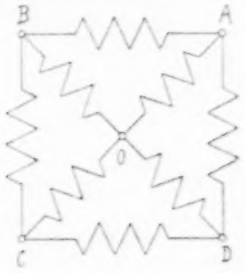


Fig. 1.

B, C, and D represent the mains. Then we can either put the lamps or the motor windings between A B, B C, C D, and D A, or we can join together the four ends of the lamp circuits or motor windings as in A O, B O, C O, and D O. The first method is called a mesh-winding, and the second a star-winding. If the volts between adjacent mains like A and B be 1,000, then between A and C they will be 1,414, and between A and O the pressure will be 707 volts. The relative advantages of star and mesh windings are about the same in practical work.

If we keep the circuits A C and B D (fig. 1) quite distinct from one another and have no mesh windings, then we can dispense with one of the mains. If we connect B and C, for example, and remove the main C, connecting, however, the main B to the third terminal of the two alternators, then the main B will carry the return current from both. As these return currents differ in phase from one another by a quarter of a period, the section of the main only needs to be increased in the ratio of 1 to $\sqrt{2}$, and not in the ratio of 1 to 2; and hence there is a substantial saving in copper in the mains, the cost of which is always a very heavy item in electric lighting or power schemes. In practice instead of having two separate alternators one is sufficient. In this case we have four slip rings on the armature spindle, and the coils connected to these rings may be wound quite distinct from one another, as in the two alternators, or may be connected up in a star or a mesh winding. In the latter cases we must, of course, have four mains. An alternating current dynamo with four terminals from which currents differing in phase by a quarter of a period can be obtained is called a two-phaser. Logically speaking, a two-phase current system ought to be called a four-phase current system, as we have four currents differing in phase from one another. A simple alternating current system is the true two-phase system, the current in one main differing in phase by half a period from the current in the other, since the two currents are always

exactly equal but are going in opposite directions.

In a three-phase system we have three mains, each carrying an alternating electric current which is not in phase with the other two. Suppose (fig. 2) that we have a bundle of

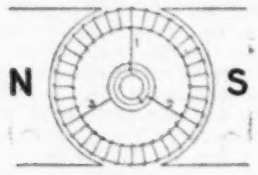


Fig. 2.

iron wires wound round with a continuous winding of insulated copper wire. Suppose, also, that this armature is placed in a magnetic field and that three points, 1, 2, and 3 on the windings, at an angular distance apart of 120 degrees, be connected to three slip rings on the spindle of the armature. Then if this armature be rotated rapidly we shall get an alternating E.M.F. between any pair of the slip rings. This machine is a very simple form of three-phaser with a mesh winding on the armature.

The mains are connected to three brushes, each pressing on a separate slip ring. If all the windings on the armature are symmetrical, then the pressure between any two mains is the same. If we use the mains for supplying power to lamp or motor circuits, then we can either connect them by a mesh or a star winding, or by both. In fig. 3 let A, B, and C be

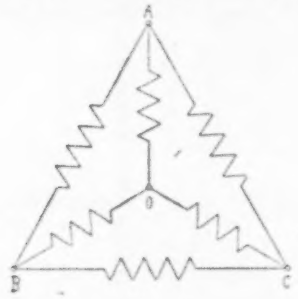


Fig. 3.

the mains, and let V be the pressure between any pair of them, then the pressure between any main and the centre, O, of the star winding will be $\frac{V}{\sqrt{3}}$, *i.e.*, 0·577 V. For example, if the pressure between A B is 1,732 volts, then the pressure between A and O or between B and O is 1,000 volts. If the resistances of the arms of the star A O, B O, and C O be all equal, then the readings of ammeters placed in these arms will all be equal. Since there can be no accumulation of electricity at O, the sum of the three currents flowing to it at any instant must be zero—that is, the sum of two of them must be equal to the third, but it must be of opposite sign. For example, we might have at a particular instant currents of 20 and 65 amperes flowing towards O from A and B respectively, and a current of 85 amperes flowing from O to C. What the ammeters measure are the effective values of these continually changing currents. The phase differences between them are a third of a period. If the shape of the current wave be a sine curve, then the magnitudes and relative phases of the three currents in the arms of a star winding are shown in fig 4. B P is the current curve in the main B.

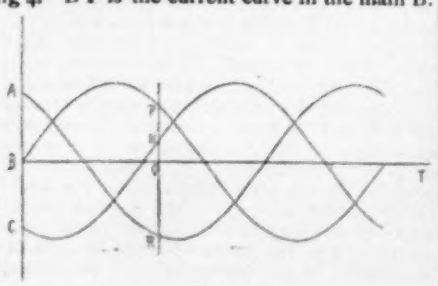


Fig. 4.

P Q is the value of the current in the main B at the time B Q. Similarly Q R and Q N are the values of the currents in the mains A and C at the time B Q. It can be shown mathematically that Q R=Q N+Q P, whatever the value of B Q; hence it is possible for the shape of the current wave in each arm of a star winding to be a sine curve. There are other mathematical curves that satisfy this condition, but in practical working the shape of each current wave is different, although we have at every instant Q R=Q N+Q P.

In order to measure the power expended in the star and mesh windings (fig. 3) we require two wattmeters. The ampere coil of one wattmeter is put in the main A, and the volt coil is connected between A and B. The ampere coil of the other is put in the main C, and the volt coil is connected between C and B. The sum of the two readings gives us the power expended. If the current (A) in each main is the same and the voltage (V) between each pair of mains is also the same, then the power being expended is $\sqrt{3}$ V A*f*, where *f* is the power factor. For example, if the current in each main is 100 amperes, the voltage between the mains is 1,000 volts, and the power factor is 0·8, then the power being expended in the circuit is $\sqrt{3}$ 1,000, 100, 0·8, *i.e.*, 138·6 kilowatts.

Three-phase currents are very suitable for transmitting power to long distances. A three-phaser is about 20 per cent. cheaper than an ordinary single-phase dynamo of equal power, and the three-phase motors are cheaper than the synchronous motors used with single-phase currents. There is also a small saving in copper in the mains with three-phase currents. Three-phase transformers and boosters are quite as efficient as single-phase transformers and boosters. It is not surprising, therefore, that three-phase currents are the most popular for power transmission schemes.

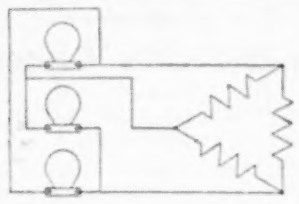


Fig. 5.

A very ingenious method has recently been suggested by Mr. C. P. Steinmetz for getting a three-phase current system from three ordinary single-phase alternators. If we connect three alternators in series (fig. 5), then it can be proved that the E.M.F.s of the three alternators will adjust themselves so that the current in the circuit of the armatures is a minimum. When this is the case the phase difference between the E.M.F.s of any two machines is a third of a period, and the powerful electrical actions and reactions between the three machines tend to keep the phase differences of their E.M.F.s all equal, just as when we have two machines in series their E.M.F.s are kept in opposition in phase. Hence, if we join three mains on to the common terminals of the three machines, we can get three-phase currents from these mains. This method of connecting up alternators is capable of extension to other cases. For example, if the three E.M.F.s of the alternators be not all equal, we get an unsymmetrical three-phase system. In the particular case when the E M.F. of one of them is $\sqrt{2}$ times that of either of the others, then we get a two-phase system, the difference in phase of the E.M.F.s of the two smaller machines being a quarter of a period.

The largest and one of the most interesting power stations in the world is that of the Niagara Falls Power Company. The turbines in the power-house drive ten two-phase dynamos, each of 5,000 h.-p. A peculiarity of these dynamos is that the shaft is vertical, the field rotating horizontally about an internal stationary armature. This type of dynamo is sometimes called the "umbrella type," and it is now not uncommon in water-power installations. The power generated is transmitted to Buffalo, a distance of twenty-five miles, for lighting purposes and running tramways. It is also distributed to various factories that have sprung up in the neighbourhood of the Falls. It is to be noted that although the power is generated by two-phase dynamos, yet the two-phase currents are converted into three-phase by means of static transformers before they are transmitted to Buffalo. Again, although the factory of the Union Carbide Company, which takes 15,000 h.-p., is only two miles from the power-house, yet it has been found advisable to convert from two-phase to three-phase for the transmission.

A very interesting continuous-current plant for power transmission has been designed by M. Thury at Genoa. He uses direct-current dynamos in series at the power-house so as to get a pressure of 8,000 volts, care being taken to insulate the turbines from the dynamos and the dynamos from earth and from each other. At the power station in Genoa he uses insulated motors coupled in series so as to take this high electric pressure. Excellent results have been obtained by this system, and in a scheme for power transmission only, and not for power distribution, this high-pressure direct-current method has many advantages.

GENERAL BUILDING NEWS.

CLONFERT CATHEDRAL.—The rector of Clonfert is making an appeal for help to complete the restoration of Clonfert Cathedral. The Cathedral, which was founded in the year 558, is situate in County Galway. During the last six years a considerable portion of the work of restoration has been carried out in accordance with the plans of Mr. J. F. Fuller, F.S.A., architect. A sum of 2,225*l.* has been expended, and the restoration of the chancel and sacristy is now complete. The nave is partially restored. Contributions have fallen off, and the work has had to be stopped for want of funds. A sum of 2,000*l.* is still required to finish the restoration of the nave and rebuild the transepts.

CATHOLIC CHURCH FOR DUMBARTON.—On the 3rd. inst., in the Dumbarton Dean of Guild Court, plans were passed for this new church, which is to be erected on a site in Strathleven-place from designs by Messrs. Dunn & Hanson, architects, Newcastle-on-Tyne. The style of the building is to be Early English. There will be sitting accommodation for 1,000 people.

PRESBYTERIAN CHURCH, BIRKENHEAD. — This church was reopened on the 2nd inst. after being closed for renovation and decoration. The work, which has entailed an outlay of about 400*l.*, includes the introduction of the electric light both in the church and the schoolroom underneath. The seats have been repainted and recushioned, and the walls decorated. The work of renovation was carried out to the designs and under the supervision of Mr. W. Glen Dobie, architect.

BOARD SCHOOL, GATESHEAD.—A new Board school in Rose-street, Gateshead, was opened on the 10th inst. The school has been erected from the design of Mr. W. H. Dunn by Mr. T. Hunter, of Washington, the sub-contractors having been Mr. Chas. Nicholson, slating; Mr. Dellow, painting; Messrs. Walker & Coxon, plumbing. Messrs. Emley & Co. supplied the hot-water apparatus. Mr. Wm. Flynn acted as clerk of works.

PRIMITIVE METHODIST CHAPEL AND SCHOOL, MATTISHALL, NORFOLK.—On the 5th inst. a new Primitive Methodist chapel and school were opened at Mattishall. The architects were Messrs. Kerridge & Sons, of Wisbech, and Mr. L. King, of Mattishall, was the contractor.

SCHOOL FOR MANUAL INSTRUCTION, ALLOA, N.B.—On the 3rd inst. Sir John Neilson Cuthbertson, Chairman of Glasgow School Board, opened a new school for manual instruction which Mr. A. P. Forrester Paton, of Inglewood, has erected at his own expense and presented to the Alloa Burgh School Board. The new building has been built on a site at the south-east corner of the Academy playground, from plans prepared by Mr. R. A. Bryden, architect, Glasgow. The workshop, which is a one-story building, contains benches for thirty pupils, along with drawing-desks. Immediately to the front of the drawing desks is a desk erected for the instructor. A working lathe is provided in the workshop, along with showcase for work done and samples. The workshop is entered by a porch, and is formed with an open roof about 20 ft. in height. The workroom is fitted with windows on both sides, and also roof light. The building is heated with hot water, and there will be a store for wood. The ventilation is on natural principles, assisted by Munn's patent ventilators on the centre of the roof. The contractors for the different works were:—Mason work, Messrs. G. & R. Cousin; joiner, Mr. R. Cairns; plumber, Mr. J. Philp; slater, Mr. R. M'Farlane; plasterer, Mr. J. Walker, Alva.

LIBRARY AND MUSEUM, WESTON-SUPER-MARE.—Weston-super-Mare has been provided with a permanent memorial of the Queen's Diamond Jubilee in the shape of a new library and museum, in the Boulevard, which was opened on the 3rd inst. by Sir Edward Fry. The scheme has not been completed, for at some future day it is proposed to extend the building back to Baker-street, and thus to utilise the whole of the site acquired for the purpose, the total estimated cost of the whole scheme being about 6,000*l.* The building contains, on the ground floor, a reading room, lending library, reference library, and ladies' room; all these are in one apartment 20 ft. high, divided up by dwarf screens with glass panels, so that the librarian can overlook the whole. There is also a librarian's room on this floor, and a repairing room above on a mezzanine floor; there are also lavatories for ladies and gentlemen. In the entrance hall are the main stairs of the upper floor, containing two galleries

adapted for picture gallery and museum purposes; these are lighted principally by roof lights on the north side. The whole building is warmed by low pressure hot water apparatus, and all the floors are laid with wood block flooring in concrete. The elevations are treated in a free Renaissance style, the ground floor up to the sills of bay windows being faced with local blue stone and above with red Cattybrook brick and Bath stone dressings. The front to the Boulevards is enriched with carvings, with a symbolical panel over the entrance arch, and figures representing chemistry, sculpture, engineering, literature, painting, and pottery in panels on either side. The architects are Mr. Hans F. Price and Messrs. Wilde & Fry, of Weston-super-Mare, acting as joint architects. The general contractor is Mr. Charles Addicott, of Weston-super-Mare. The sculpture of the two groups of figures on the front pilasters is by Messrs. Harry Hems & Sons, of Exeter, and the rest of the carving by Mr. Hillman, of Weston-super-Mare.

VICTORIA HALL, ELLON, ABERDEENSHIRE.—On the 1st inst. the foundation-stone was laid of the new Victoria Hall in course of erection at Ellon. The hall, which is being built to the plans of Mr. William Davidson, architect, Ellon, in conjunction with Messrs. Jenkins & Marr, Aberdeen, at an estimated cost of 2,500*l.*, occupies a site on the south side of Station-road, and is built of Peterhead granite.

BATHS, CHELTENHAM.—The new baths on the site of the old Montpelier Baths at Cheltenham were opened on the 10th inst. The external appearance of the building has undergone very little change, but internally a complete transformation has been effected. The large swimming-bath remains. The private baths are in an adjoining building. On the ground floor are some of the first-class baths, while on the floor above are two first-class baths and three second-class baths. The work was carried out from plans by Mr. Hall, the Borough Surveyor.

INSTITUTE, BARNSTABLE, DEVON.—The foundation stone was laid on the 7th inst. of the new "Alfred Miller" Institute. The building, which is in the Early English style, will be about 128 ft. long by 54 ft. wide, the top spire rising about 60 ft. from the ground level. The walls will be of Wellington red bricks, with stone dressings, and the window arches, &c., will be picked out in red brick, while the roof will be of red Bridgwater tiles. On the ground floor will be four rooms, 25 ft. by 19 ft. 7 in., which will be adapted as reading and recreation rooms for the men and women, with lavatory and cloakrooms, &c., attached. A corridor 82 ft. long extends the whole length of these rooms, French casements opening out on a verandah, 6 ft. or 7 ft. above the ground level. At one end will be the caretaker's house, also the refreshment-bar, with separate casements communicating with the corridor for the men and women. On the first floor, the large lecture hall will be 82 ft. by 25 ft. At the higher end will be a platform, 25 ft. by 20 ft., with recess for an organ, and dressing-rooms at the rear. These open into a corridor with lavatory, &c., accommodation, and provided with a separate exit. One of the features of the building will be the three-storied 60 ft. clock-tower, surmounted by a circular red roof. The tower will also form the entrance to the lecture-hall. The chief entrance on the ground floor will be on the south side, approached by steps with ornamental wings. Above the verandah the full length of the corridor, 82 ft., will be an iron balcony. The building will be heated by means of hot-water pipes. Messrs. Sanders & Karslake are the contractors, Mr. A. G. Trevena is the clerk of works, while the architect is Mr. James Crocker, F.R.I.B.A.

BUILDING IN ABERDEEN.—The new St. Ninian's Church, Midstocket-road (Mr. W. Kelly, Aberdeen, architect), was dedicated on 5th inst.——Skene-street Congregational Church has received extensive additions and redecoration (Mr. A. Marshall Mackenzie, A.R.S.A., Aberdeen, architect), and a new apse is being built at Free East Church.——At Free South Church a new organ has been introduced at a cost of 1,500*l.*, and alterations are to be made at Queen's Cross Free Church so as to allow the position of the organ there to be shifted.——It has been resolved that the walls of the new electric station at Ferryhill shall not be raised to a greater height than the width of Dee Village-road adjoining. The chimney for the new station will be 200 ft. high, octagonal in plan, and of an ornamental character. The tender for the supply of poles for the electric tramways extension for the Corporation, lodged by Messrs. Macartney & McElroy, of Glasgow, being the lowest, has been accepted. For the supply of rails that of Messrs. M'Lellan, Glasgow, representing a German firm, has been accepted.——The School Board's architect has been instructed to submit designs for remodelling and enlarging Rosemount Public School, and the plan of the new Central School, School Hill, has been approved of by the Scotch Education Department. Certain schools are to be repainted in the autumn, and a janitor's house at Kittybrewster School is to be proceeded with at once.——Ten dwelling-houses are to be erected in Ashgrove-road, and a block of houses and shops at the junction of George-street and Hutcheon-street.——The Plans Committee of Aberdeen Town Council have sanctioned the following plans:—Dwelling-house on the north side of Rubislaw Den South for Mr. W. J. Riddell, per Mr. Arthur Clyne, architect; two dwelling-houses on the north-east side of Skene-square for Mr. Archibald Robertson; dwelling-house on the west side of Clifton-road (being one of five sanctioned on April 20, 1899), for Mr. Joseph Shirras, builder; stable on the south side of Upper Denburn for Mr. William Topp, per Mr. Alexander Thomson, builder; stores on the north side of St. Clement-street, for Messrs. G. and W. Davidson, per Mr. Alex. Thomson, builder; alterations and additions in connexion with the Royal Aberdeen Hospital for Sick Children—for the directors, per Mr. A. Marshall Mackenzie, architect; seven dwelling-houses on the south side of Wallfield-place, for Messrs. Pringle & Slessor, builders, per Mr. Peter Slessor, architect; alterations in connexion with Drill-hall, Woolmanhill, for the 1st Volunteer Battalion Gordon Highlanders, per Mr. A. H. L. Mackinnon, architect; alterations and additions in connexion with the property, No. 96 Holburn-street, for Mr. James Munro, plumber. The Finance Committee have sanctioned the elevations of the following buildings on ground belonging to the Town Council—two dwelling-houses on the north side of Belgrave-terrace for Mr. William Garvie, builder, per Mr. William E. Gauld, architect; dwelling-house on the south side of Rosebank-terrace, for Mr. John Sutherland, carpenter; alterations on dwelling-house, No. 379, Union-street, for Dr. J. C. Ogilvie Will, per Mr. John Cameron, architect; alterations and additions on No. 115, Union-street, for Mr. R. K. Smith, hatter, per Mr. Robert G. Wilson, architect.

MARKET, LEICESTER.—The foundation-stone was laid on the 6th inst. of the new wholesale market in Halford-street, Leicester. The new market, when completed, will stand on an area of about 3,850 square yards, and will contain, at the Halford-street end, a building having offices set apart for the officials of the market. The building is divided on the front below the first floor by a large central archway and road for the use of vegetable carts and waggons. On either side of this archway entrance the offices have their entrances, direct from the street, while access is also obtained through doorways leading direct from the market. At each end of this building a lock-up shop is placed, and over the same, on a mezzanine floor, storerooms are provided. All the offices which will be used by the officials are situated on one side of the building, viz., on the western side of the entrance gateway. In a basement there are offices for the inspector of weights and measures and the meat inspector. On the mezzanine floor are lavatories and conveniences. The superintendent's office has a central position on the first floor at the back of the front building. There is a separate office also for clerks and collectors, while other offices are placed on this floor on both sides of the building for letting purposes. The floors are constructed of concrete supported by rolled steel joists. The whole of the other portion of the site is to be used by the wholesale vegetable and fish merchants. A roadway of 23 ft. wide will run through the market, and at the sides of this twenty-three vegetable stalls are placed with offices over, each pair being approached by one staircase. Into Yeoman-street double doors are provided, which will enable the stallholders to have goods delivered by these entrances. These stalls will be fitted with B. and S. folding collapsible gates, and are so arranged that two can be made into one large one if desired. The main walls of this market are carried on steel girders, the width between the walls inside being 50 ft. Steel lattice girders 5 ft. deep, with arched soffit, run the full distance across, and support the different spanned roofs, having steel principals varying from 32 ft. 4 in. to 57 ft. 6 in. The portions of the roof not glazed will be covered with boarding and pan tiles. Two archways are placed in Yeoman-street to be used as exits only for both markets, and opposite the one at the lower end of the street a space is left for the unloading and loading of carts and waggons using the cold storage, and these conveyances can either pass out of the exits before mentioned or use an exit provided for them in particular opening into Wigston-street. Around this portion there is a "trolley" way which gives access to the basement under the fish market. A direct-acting low-pressure hydraulic goods lift to carry 20 cwts. is so arranged that it can be used either direct from the fish market or off a lower level from the "trolley" way. The fish market entrance is from Vestry-street. It is divided into twenty-one stands, the division lines being marked by the columns supporting the girders carrying the offices over. The offices over are approached by circular iron staircases, one for each pier. The hawkers will have a fish washing-room approached from Yeoman-street near to the large exit. Between the main walls of this portion of the building, which is carried on an arcade of elliptical arches and piers, is a 51-ft. steel span roof, covered with pan tiles, and having light introduced on the north side by patent glazing. The floor of this market, which is over the basement, is constructed of concrete, with rolled steel joists and girders, supported by steel stanchions. A refreshment-room for the stallholders' use is placed on the first floor over the trolley-way, and is approached by a stone staircase. Adjoining this is a kitchen. On either side of the large exit in Yeoman-street, situated in a basement, are conveniences for buyers and stallholders. The total cubic capacity of the cold stores will be about 32,500 ft., and it will be maintained at a temperature of about 25 deg. Fahr. The engine-room is situated in the basement at the Vestry-street end. The remaining portion of the basement is given up to the cold storerooms, a trolley-way, engineer's store, &c. The market will be lighted by electricity. The whole of the front building is faced with terra-cotta, having a plinth of semi-glaze; the dressings of the other external portions of the buildings and portion of the interior are of the same material, the facings to the markets proper being Woodville sand-faced bricks. The roof to the front building is to be laid with Broseley tiles. The large archways will be fitted with B and S folding and collapsible gates. The interior facings of the markets are Whitwick white bricks with red bands, a dado being formed all along the vegetable market and around the whole of the fish market of cream-glazed bricks with coloured bands. The roadway will be formed of Val de Travers asphalt, with a Mountsorrel granite curb, and the stalls and standings will be laid with granolithic concrete. The drains are to be constructed with Syke's patent socket-jointed stoneware pipes. Mr. Walter Brand, of Leicester, is the architect, the competitive designs originally sent in by him having gained the first premium. Mr. Thomas Herbert is the contractor for the building, with Mr. William Charles Lee as clerk of the works.

THEATRE, PERTH.—The new theatre for Perth, which has been in course of erection for the past fifteen months, is now almost completed. Mr. William Alexander, City Architect, Dundee, is the architect of the building. The theatre measures 120 ft. in length from north to south and 60 ft. from east to west. The principal entrance is from High-street, leading into a corridor covered in with an ornamental iron and glass roof, and by two short flights of steps terminates in a vestibule on the box floor. From this there are entrances into the private boxes, dress circle, upper circle, orchestral pit, and stalls. The latter have an extra exit in the Cutlog Vennel. The pit is entered from the same place, and is on the same level, while the gallery is entered from off Mill-street or by the passage off Cutlog Vennel, round the front of the building and underneath the vestibule. The sitting accommodation upon the floor includes two private boxes, which are capable of holding four persons, sixty-nine orchestral stalls in four rows, and about forty-two pit stalls in two rows immediately behind the orchestral stalls, while the pit itself is seated for 338 in thirteen rows. On the dress circle level there are two other boxes, the dress circle itself being seated for seventy-eight persons. Immediately behind this is situated the upper circle, but having a separate entrance from the lobby above that of the dress circle, which has five rows of seats, accommodating 105 persons. The gallery will seat 300 people. The theatre is seated altogether for about 950. The proscenium is 26 ft. wide. The stage from the footlights to the back wall measures 34 ft., and has a width of 56 ft. In the meantime the building will be lit with gas, but provision has been made whereby the electric light may be introduced as soon as a supply of the current can be got. There will be a refreshment-room on each of the floors. The following were the contractors:—Mason and brickwork, Mr John Carnegie, Dundee; joiner work, Mr. William M'Quibban, Perth; slater work, Mr. James Buchan, Perth; plumber work and gasfittings, Messrs. Frew, Watson, & Co., Perth; steel work, Messrs. Thomas Gibson & Son, Edinburgh; glazier work, Mr. Charles Alexander, Perth; electric light apparatus, bell-hangings, &c., Messrs. A. Westwood & Son, Dundee and Perth; ornamental plaster work, decorations, and seatings, Messrs. A. & R. Dean, Limited, Birmingham; painting work, Messrs. George Muirhead & Son, Perth; clerk of works, Mr. Thomas L. Kay.

HOTEL, BLOOMSBURY.—A new temperance hotel has been erected in Hart-street, Bloomsbury, on land to the east of and adjoining St. George's Church. The Kingsley Hotel, as the new hostelry is called, has all the necessary general accommodation for a first-class hotel on the ground and basement floors, with 100 bedrooms and private sitting-rooms on the floors above. The front and part of the west elevations are in Ancaster stone, from the Lindley quarries, and Ibstock red bricks, the main entrance having Swedish dark green polished granite dressings. The part of the elevations nearest the church are faced with ivory white glazed bricks from the Farnley Company. The building throughout is of fire-resisting material. The general contractors were Messrs. Holland & Hannen, the sub-contractors being as follows, viz.:—Granite, Messrs. Whitehead & Sons; Constructional Steelwork, Messrs. Wedekind & Son; Marble, Messrs. Fenning & Co.; Heating and Hot Water, Messrs. Clement, Jeakes, & Co.; Fireproof Flooring, Messrs. James & Co.; Plumbing and Sanitary Fittings, Messrs. Doulton & Co.; Lifts, Messrs. Smith & Stevens; Stone Carving, Messrs. Butcher & Axtell, the medallion of Charles Kingsley being from a model by Mr. Henry C. Fehr; Mosaic, Rust's Vitreous Mosaic Co.; Wrought Ironwork, Mr. R. Kirsch and Messrs. Hill & Smith; Bronze Shields and Band and external Iron Lamps, Messrs. Singer & Sons; Electric Wiring, Fittings, Telephones,

and Bells, Messrs. Sotheby & Co.; Locks, Door Furniture, &c., Messrs. C. Smith, Sons, & Co.; Parquetry Flooring, Messrs. Howard & Sons; Stoves, The Coalbrookdale Co.; Gas Cooking Apparatus, Messrs. Fletcher, Russell, & Co.; Chimney-pieces and Overdoors, Mr. W. G. Groves; Copper Roofing and Lightning Conductor, Messrs. Ewart & Son; Stained Glass, Messrs. A. L. Moore & Co; Iron Casements, Messrs. Burt & Potts. Mr. Richard Owen was clerk of the works, and Mr. Wickeson general foreman. The designs were prepared by Mr. C. Fitzroy Doll, architect, of Bloomsbury.

SANITARY AND ENGINEERING NEWS.

WATER SUPPLY, TORPOINT, CORNWALL.—The water supply of Torpoint has been augmented by pumping into the reservoir water coming from springs at a lower level. A new engine, an oil engine by Crossley Brothers, of 6½ h.-p., has been installed, and a collecting tank of 350,000 gallons capacity has been constructed. The work was carried out under the supervision of Mr. W. C. Harris, Water Engineer.

STAINED GLASS AND DECORATION.

WINDOW, GIGGLESWICK, YORKS.—A stained-glass window of three lights to the memory of Annie Batten, of Stainforth, Settle, the subject being "The Good Shepherd," has just been erected in the north aisle of Giggleswick Church. The window is from the studio of Mr. T. W. Camm, of Smethwick, who has also executed the chancel and other windows in the same church.

MEMORIAL WINDOW, FREE SOUTH CHURCH, ABERDEEN.—There has just been placed in this church a stained-glass window to the memory of the late Mr. John Cook, of Ashley. The subject of the main panel is found in the words, "Suffer little children to come unto Me, and forbid them not." The artist is Mr. R. Douglas Strachan, Aberdeen.

WINDOW, RODINGTON CHURCH.—The Rector of Rodington Church, near Shrewsbury, has recently erected a window and brass to the memory of his parents, Christopher and Anne Smith, in the south aisle. The window consists of two lights and tracery, and the subject is "Christ and Peter and Anna at the Presentation in the Temple," while in the tracery is a figure of the patron saint, George. Below the window the brass bears the inscription and date. The work is from the studio of Mr. T. W. Camm, Smethwick, near Birmingham.

MISCELLANEOUS.

HOUSING OF THE WORKING CLASSES, PERTH.—The question of the housing of the working class has, says the *Dundee Advertiser*, been a burning one in Perth for a long time, many of the dwellings erected in different parts of the city being unsuitable for the wants of the class in question. Some time ago a scheme was started by the Police Commission for the erection of a number of blocks, and a piece of ground at the corner of the Old High-street and Milne-street was secured for the erection of houses for the working men. Plans were prepared by the Burgh Surveyor, and two blocks were proceeded with. The building, which is now nearing completion, comprises twenty houses in each of the two blocks. The structure is plain but substantial, the front elevation being built of red sandstone from Corncaple Quarry, Dumfriesshire. Each block is three stories high. There are three classes of houses, ranging in rental from 8*l.* 10*s.* to 5*l.* The houses have all two apartments—a kitchen and a parlour. In the higher-rented class the kitchen is 14 ft. in length, exclusive of a bed recess 9 ft. square. The height of the room is 9 ft. 10 in., and the length about 13 ft. There is a tiled fireplace in the rooms, while the kitchens are fitted up with ranges with self-heating ovens. The only difference between the 8*l.* 10*s.* and the 7*l.* 10*s.* houses is that there is no fireplace in the room of the latter. All the houses, of course, will be supplied with gas and water. There is wash-house accommodation, two tubs and a large boiler being connected with each wash-house. The whole of the open court is concreted. There are still another two blocks to be erected. The following were the contractors:—Mason work, Mr. Michael Kerrigan; joiner work, Mr. D. Crichton; slater work, Mr. Daniel M'Lauchlan; plumber work, Mr. A. J. Davidson; iron work, Mr. William Hume; plasterer work, Messrs. John Peebles & Sons; painter work, Mr. P. K. Donald, Blairgowrie; clerk of works, Mr. Alexander Robertson.

HOUSING OF THE WORKING CLASSES, HULL.—The Joint Committee of the Hull Progressive party, the Hull Trades and Labour Council, and the Hull Co-operative Society appointed to consider the question of the housing of the working classes in Hull have issued the following Report:—As to the question whether there is any over crowding in Hull, the Committee gives the following table showing how the different districts in Hull are populated. They are set out in registration districts:—Persons per acre: Marfleet, 0·2; Newland, 4·4; Stoneferry, 1·7; Newington, 15·3; Drypool, 20·2; Sutton, 4·76; East Sculcoates, 53·2; Myton, 64·9; West Sculcoates, 93·3; Humber, 95·5. Further, in the old city alone, that is, in the area between the old docks, there are 449 rooms let off to separate families. This is not, of course, reckoning the almshouses or caretakers of offices. In Newington, Drypool, and Sutton districts there are dozens of acres not built upon, and in the Humber district there are scores of acres of water space, and the Committee thinks the over crowding is very evident, for the number per acre rises to the fearful rate of at least 200 per acre in several areas, while in exceptional areas even up to 400 persons per acre. The average number per acre in overcrowded London is only 56. As to whether there is a dearth of suitable and healthy dwellings, the Committee say the official returns of the population of Hull and number of houses are as follow:—1897, population 225,715, houses 55,667; 1898, population 229,887, houses 56,261; 1899, population 234,270, houses 56,861. This shows that, although in two years the population had increased in round numbers 9,000, the new houses in the same period were only 1,200; whereas by the increase of population, and calculating 4½ persons to a house, which is about the usual average, there should have been 2,200. As 1,200 houses, at 4½ persons per house, would accommodate about 5,000, it shows that 4,000 persons were added by this means alone in the last twelve months to the already overcrowded areas in the city. The Committee holds that certain alterations in the present law of the land are necessary to meet the requirements for housing the people, and is of opinion that the following recommendations should be brought prominently before the electors at the forthcoming municipal elections:—That the City Council avail itself of the Cheap Trains Act; that workmen's cars be run at half-fares at suitable times, and that as soon as possible all tram fares in the city be reduced to ½d.; that the City Council adopt Part 3 of the Housing of the Working Classes Act, 1890, and then appoint a committee to purchase land and build houses as soon as can be done; that the Sanitary Committee's recommendations with regard to the substitution of water-closets for privies in the 36,000 houses in Hull that either have no back way, or in which the privies are within 6 ft. of the dwelling-house be carried out as soon as possible. The Committee calculates that there is a total of over 6,000 people who have to live somewhere, for whom no extra accommodation has been supplied, and conclude that there is a dearth of suitable and healthy dwellings. The Committee thinks that the municipality should be called upon to provide houses for the working classes—firstly, because the large majority of workmen's houses are grossly insanitary. There are in Hull 56,871 houses, and of these, as near as can be ascertained, 46,000 are workmen's dwellings. Of this number no less than 36,000 either have privies within 6 ft. of the doors or windows of the dwellings, or have no back ways. Secondly, private enterprise does not provide nearly enough; and thirdly, because the municipality have disboused so many people, having taken houses away for various reasons, should provide other houses. Other reasons are to check the growing rents, and because overcrowding causes a high sick and death rate. One child out of every five in Hull dies before it reaches the age of one year.—*Eastern Morning News.*

THE HOUSING PROBLEM.—At the meeting on the 7th inst. of the Trades Union Congress at Huddersfield Mr. Bowerman moved a long resolution urging the importance of trades unions securing the adoption of Clause 3 of the Housing of the Working Classes Act by municipalities, and asking for the amendment of the Act by provisions dealing with the owners of unhealthy houses, the extension period for repayment of loans to 100 years, and the creation of fair rent courts. He said it was impossible to expect a healthy and stalwart race to grow up under the shocking conditions which existed in the slums of large towns. Mr. Walsh seconded the proposition. Mr. Steadman, M.P., said the result of cheap train fares in London had been to raise rents in the suburbs, and two or three shillings a week saved in transit had gone into the pockets of the landlords. No Government would solve the housing problem until it had the courage to tackle the land question. Mr. A. Wilkie supported the proposition, which was carried.

THE WORKMEN'S COMPENSATION ACT.—At the meeting on Thursday, last week, of the Trades Union Congress in Huddersfield the following combined resolution was submitted by a number of the trades:—"That, in the opinion of this Congress, it is desirable that many amendments to the clauses of the Workmen's Compensation Act, 1897, should be made, and that the principles of the Act should be extended to all trades and occupations both on land and sea." Mr. Richards (miner, Ebbw Vale), moved the resolution, which was seconded by Mr. Sexton (Liverpool). Several delegates intimated that they had not had an opportunity of attending the Conference which resulted in the drawing-up of the joint resolution, and the matter was again referred to the Standing Orders Committee. Mr. Ben Tillett (London) moved:—"That, in view of the increasing number of lock-outs and refusal by employers to arbitrate, we urge the Government to pass a Compulsory Conciliation and Arbitration Act, and the appointment of Judge and Court with authority to enforce awards by fines and imprisonment of persons refusing to accept the award of such Court; and that Judges have full power, as under the Company Laws, to call for the production of all records dealing with wages and working expenses of any firm or bodies of men or employers interested in a dispute." Mr. H. Orbell (London) seconded the resolution, which was opposed by Mr. J. Ward (Navvies), who contended that each dispute should be taken separately on its merits, and that the workmen should have a voice in the choosing of the arbitrator or conciliator. On a show of hands the resolution was declared to be lost, and on Mr. Tillett demanding a vote by card the result was:—For the resolution, 246,000; against, 939,000. The President therefore declared the resolution to be lost. As a result of the second Conference it was agreed to submit the following resolution on the subject of the Workmen's Compensation Act:—"That, in the opinion of this Congress, it is desirable that many amendments to the clauses of the Workmen's Compensation Act, 1897, should be made, and that the principle of the Act should be extended so as to include all accidents in all trades and occupations both on land and sea, and that the Parliamentary Committee are hereby instructed to prepare legislation in order to give effect to the above resolution." Mr. Edmund Browne (Standing Counsel to the Parliamentary Committee) explained how in the Bill which he had drawn up amending the Workmen's Compensation Act the various objections were met. The resolution was carried.

TRADE NOTES.—A gold medal has been awarded to the Campbell Gas Engine Company, Limited, for their exhibit of gas and oil engines at the Paris Exhibition, and seven members of their staff, foremen, and workmen have been awarded silver and bronze medals for the work which they have done in connexion with the exhibit.——The plastering in the sanitorium now being erected in "Pinewood," near Wokingham, is being done with Bassett's Patent Plaster.——Tondu Board Schools are being fitted with the "Small Tube" Hot-water Heating Apparatus by John King, Limited, engineers, Liverpool.——Messrs. E. H. Shorland & Brother, of Manchester, have just supplied some of their patent Manchester grates to the Dairy Episcopal Training College, Edinburgh.

CAPITAL AND LABOUR.

DUNDEE JOINERS' STRIKE.—A settlement has been arrived at in the dispute in the Dundee joiner trade. A meeting of the Dundee Master Joiners' Association was held on the 4th inst. to consider the position, which, from the employers' point of view, had been greatly weakened by the secession of one of the Associated firms who had agreed to pay the rate of wages determined on by the Operative Society—9d. per hour. The action of this firm was criticised by several of those present, but it was pointed out that their position and the matter of exacting a money penalty would be considered at a future meeting. In view of all the circumstances, the Association, after a sederunt lasting thirty-five minutes, agreed to accede to the men's demands—namely, to withdraw the notice of a reduction, and pay the wages at the former rate. The joiners will consequently resume work on an early date. The strike has lasted fully three weeks. The master joiners intimated a reduction of ½d. per hour on the operatives' wages, which the workmen resented. The employers offered a compromise to the men of ½d. per hour, with a further reduction of ½d. three months afterwards. This was also refused, and on August 8 the employés decided to leave their work. The operatives employed by the Associated firms—numbering twenty-five — withdrew their labour, and over 200 men were thrown idle.—*Dundee Advertiser.*

STRIKE OF STOCKTON PLUMBERS.—The operative plumbers in Stockton have come out on strike for an advance of one penny per hour in their wages. At the present time the men are receiving 8½d. per hour, and they now demand 9½d., which means an advance of 4*s.* 5*d.* per week.

RECENT PATENTS:

ABSTRACTS OF PATENTED INVENTIONS.

9,880.—A DREDGING APPLIANCE: *T. O. Newmann.*—On to a common shaft are pivotted two jaws, each of which consists of two parts, whereof one part is fixed to plates that are pivotted on to the other part in order to allow for small relative displacements vertically. Through slots in the jaws passes a stop-bar which is joined with pivotted rods to lugs upon the above-mentioned latter parts of the jaws, and is connected with ropes to a pull-rope, and with a shackle to a second pull-rope that is joined with other ropes to the jaws, there is also a steering machanism for the rudder; the jaws are held in a closed position as the dredge is pulled into its place, the dredge is then opened and worked with the pull-rope.

9,893.—APPARATUS FOR EXCAVATING: *T. Whitaker.*—For excavating trenches and kindred operations is devised a lattice-work jib affixed to a vertical pivot. The arm for the bucket is moved along guide-rollers with a rope passing around a

drum, and having its free ends joined adjustably to the arm. When the bucket's position has been adjusted by the revolution of the drum, excavation is carried out by means of the crane-rope fastened to the bucket and of the working of the winch.

9,910.—WASH-OUT CLOSETS: *R. G. Howson.*—A small chamber is provided at the back of the basin, out of which the flush flows at one and the same time into the flushing-rim, and through a passage formed in one piece with the basin, into a jet turned upwards in the siphon's inlet. The passage has an air-pipe, and the starting of the flush is accelerated by forming the outlet with an oval section in two places just above its lower outlet.

9,925.—WOODEN PIT-PROPS: *W. H. Hepplewhite.* In order to prevent the props from becoming broken the inventor fashions them with their ends tapered, so that they shall give way and spread when subjected to an excessive load or pressure.

9,963.—DRAIN-TRAPS: *F. Elder.*—It is arranged that the flow and backflow of the sewage shall automatically open and close respectively the trap's valve, which is carried by a hollow stem in whose upper end is a piston that moves within a cylinder which is closed with a cap; the cylinder's lower end has a pierced diaphragm, the apertures being closed with flap-valves. Under normal conditions the valve remains shut, but as soon as waste water has entered the water flows through an opening into a tank, and the ascent of a pivotted float inside the tank opens a valve in the service pipe, whereupon water passes through a side pipe into the cylinder and lifts and opens the valve. In another form of the contrivance the backflow is similarly utilised to force water under pressure into the cylinder's upper end, and thereby to close the valve.

9,966.—CONDUITS FOR ELECTRICAL CONDUCTORS: *F. Tungbluth.*—The tubes are fashioned, by means of a roller-press, of an admixture of powdered unslaked clay lime, Val de Travers asphalt, Trinidad asphalt, coal-tar, and cement. The several ingredients are pounded together when in a heated state.

9,991.—WASH-OUT CLOSETS, FLUSHING, &c.: *G. B. Howell.*—A valve admits the flushing water into a cylinder which is held cross-wise in a web that is put between the rising and falling legs of the basin's outlet siphon; a channel turns the flush from the cylinder to the crown of the siphon, and another channel turns it to the flushing-rim, whilst at the same time a part of the flush flows directly through a passage to the outlet. In another shape the outlet's end is made vertical-wise, being joined by means of a flanged joint to a horizontal soil-pipe that may therefore be set in any desired direction, or the pipe may also be first caused to enter a small chamber whose contents will then seal the outlet as they leak into the basin.

9,993.—A LEVELLING INSTRUMENT: *G. Langer.*—A central web having around it a broad flange, which together with plates serves to carry the instrument's working parts, constitutes the casing, on to which a telescope, if needed, is secured with standards. A spindle carries a pointer that turns over a fixed scale, a spirit level, and a large wheel which gears with a pinion upon whose spindle is mounted a vernier arm for the taking of fine readings upon a scale. If the instrument is laid upon an incline the spirit-level is set horizontally by the turning of a milled button, when the gradient rate may be read off with exactness from the two scales. A pinion also is placed in gear with the large gearing-wheel, and on its spindle are four points turning over as many concentrical scales, each of which is marked with twice as many divisions as are marked upon the next scale which is nearer to the centre, the innermost scale being graduated for the angles of displacement which are needed for sighting the consecutive divisions upon a standard 100 ft. distant; from the three other scales the smaller readings for remoter points can be obtained.

10,019.—LIFT AND BALL-AND-FLOAT VALVES: *W. Bradley.*—For use with water supplied under high pressure is contrived a tubular float valve whose edge will engage with a seating which is retained in its position by means of a screw cap, and the valve is caused to slide through a cup-leather; the invention comprises a float-mechanism wherein a weighted lever is sustained with a spring catch which is moved by the float-lever's action upon a cam-shaped projection; or there may be employed a solid valve, so recessed as to fit tightly over the end, projecting upwards, of the outlet nozzle which keeps the seating in its place; the valve is adapted for use with a bib-cock or with a screw-down spring-pressed stop valve.

10,045.—ROOF GLAZING: *C. Conlon.*—Side ribs are shaped upon the glass sheets so that water shall not pass by the joints, and in order that the sheets may be fitted closely together their lower overlapping corners are bevelled; for fastening the sheets on to wooden or metallic purlins or astragals are used flanged strips or roll-caps made of sheet-metal, to be secured with screws that have recessed or mushroom-shaped heads which will fit over the up-turned edges of the holes in the caps; short perforated inserted or cross-tie pieces serve to strengthen the caps at the holes, and the ends are flanged or stepped so as to provide stops for the glass and roofing plates; the glass sheets may be fastened on to the caps between the purlins with intermediate T-shaped clamping screws and mushroom-headed nuts.

10,047.—TILES FOR ROOFING PURPOSES: *H. Ludeling.*—The interlocking tiles have passages through which the air may circulate so as to keep the building cool in warm weather; they have hanging nibs wherewith they are to be fastened on to the laths or battens of the roof, and are composed of Portland cement mixed with sand. At the base of one tile is a half-rounded groove which will fit over a corresponding rib upon the upper edge of the tile next below it, whilst a rounded rib beneath the tile's side will fit into a groove formed in the edge of the tile next adjacent. A narrow slit for the escape of air is supplied between the overlapping tiles by sinking or depressing each tile's upper surface, and bevelling or cutting-off the under side at its lower end; a space for the escape of water through leakage is made between the ribs and grooves, and communicates by means of slots with the drainage channel.

10,106.—DIGGING HOLES FOR POSTS: *W. Francis.*—A scoop for digging holes for posts, &c., is made of sheet-steel or other suitable material and has a space formed between its edges, the lower edge being sharpened, and the handle being weighted at either its end or a short distance lower down.

10,141.—A METHOD OF RETAINING LOCK AND LATCH BOLTS: *G. W. Allen and F. Green.*—For preserving bolts when shot or drawn back from being operated from without by the use of any other than the master-key the inventors fit upon the sliding handle of the latch a lever arm, upon which is a stud that passes through a slot cut in the case and through a slot cut in the lever beneath; the lever is pivotted in such a manner that parts of it rest near a ward-seating for the key, and in the travel of the key's bit. By moving the stud into two notches the latch becomes retained in the shot and withdrawn positions respectively, a spring retaining the lever in either position; the bolt, when it has been shot, may be liberated by turning the key into engagement with one of the parts of the lever, so that the stud is raised from the notch and into the straight portion of the notched slot in the case. The movements described are quite distinct from the ordinary mechanism of the lock.

10,156.—VALVES AND COCKS: *A. E. Markwick.*—A ball-float or other lever, which engages with spiral slots in and with projections upon the casing, operates a valve made of leather, indiarubber, or other material; the valve and lever are joined to a piston. The contrivance assumes various forms. The valve may be worked with a spring-pressed button which, under normal conditions, keeps the valve shut, and has a slot which engages with a pin that projects eccentrically from the piston, or it may be operated by a lever whose two hooks engage with the pin, or it may be moved with a lever pivotted in the casing and slotted so as to engage with the valve-lever's end.

10,196.—A LAMP FOR BURNING OFF PAINT, &C: *F. Hussey.*—The lamp has a band tightened with a screw, and is made in one piece with a blade whose upper edge is sharpened that it may scrape the painter's knife; to the band is attached an adjustable heat-shield or wind-guard. In other forms the guard is fixed upon the lamp with clips formed upon the lamp's extended shank, or a socket upon the shield fits over a pin upon the lamp, or the band may be dispensed with, the knife being secured to the lamp without one.

10,206.—AN ODOMETER FOR USE BY LAND SURVEYORS: *F. Stidel and E. Torkos.*—The odometer records the distance along which the hand-barrow or other vehicle is wheeled. The barrow wheel's periphery is sub-divided by projections or ridges, which are placed, in preference, at the ends of the spokes. A recording disc, having a movably fixed pointer, is driven by the axle; at each completed revolution of the recording disc a three-sided projection thereon raises a hammer that strikes a bell. If the wheel's circumference is, say, two yards, fractions of a yard are to be measured by the indents which the ridges upon the wheel make in the travelled path.

10,264.—A MACHINE FOR TRIMMING THE SIDES OF ROADS, &C.: *A. and F. Macdonald.*—By this machine, adapted for horse-draught, turf is cleared away from the sides of footpaths and roads. Of the three wheels that carry the machine, the two front wheels are independently mounted upon levers that are adjusted upon and swivel with a common axis, by which means one can control the height of the machine's front, the two wheels being then fixed in place with a link and hand lever. The hand lever has a catch which engages with a toothed quadrant. The guiding wheel's adjustment is regulated with a lever that engages with a rack between the two handles. A tusk upon the shovel-blade serves for a vertical cutting knife, and a plough-board turns the cut turf over to one side.

10,278.—CALLIPER GAUGES: *H. H. P. Powles.*—In order to facilitate with one measurement calculations as to the areas of circles and squares, a wire's electrical resistance, and so forth, the callipers are set so that they will give readings of the square, or of a ratio to the square, of the linear distance between the points. To the frame that carries one jaw is pivoted a piece upon which a slide can move, which is rigidly fastened to the vernier arm that slides upon the other leg which carries the other jaw. The vernier's displacement from zero point upon the scale is in ratio to the square of the distance between the two jaws, which may be shaped as half-round pieces that turn in the ends of the callipers' legs.

MEETINGS.

MONDAY, SEPTEMBER 17.

Sanitary Institute (Lectures for Sanitary Officers).—Mr. J. Castell-Evans, F.I.C., on "Mechanical Physics Laws of Motion, Hydraulics, &c." 8 p.m.

WEDNESDAY, SEPTEMBER 19.

Sanitary Institute (Lectures for Sanitary Officers).—Mr. J. Castell-Evans, F.I.C., on "Natural Forces Light, Heat, Electricity, Chemistry." 8 p.m.

FRIDAY, SEPTEMBER 21.

Sanitary Institute (Lectures for Sanitary Officers).—Mr. J. Castell-Evans, F.I.C., on "The Atmosphere: Pressure and Composition; Air, Combustion, and Respiration." 8 p.m.

Institute of Sanitary Engineers (Incorporated).—Examination in Practical Sanitary Science.

SATURDAY, SEPTEMBER 22.

Institute of Sanitary Engineers.—Examination in Practical Sanitary Science.

SOME RECENT SALES OF PROPERTY

ESTATE EXCHANGE REPORT.

August 31.—By FENN & Co. (at Clacton-on-Sea).
Great Clacton, Essex.—Brooker's Farm, 13 a. 3 r. 19 p., f. £1,500
September 4.—By BROWETT & TAYLOR.
Beckenham, Kent, 29, Kingshall-rd., u.t. 74 yrs., g.r. 7*l.*, r. 42*l.* 450
By WHETHERLY & HASLETT (at Masons' Hall Tavern).
Kensington.—Earl's Court-rd., the Prince of Teck, p.-h., f., with goodwill. 28,700
September 5.—By SWAN WOODCOCK (at Stratford).
Stratford.—32 to 38 (even), Blenheim-rd., f. 720
September 6.—By F. J. BISLEY & SONS.
Bermondsey.—42, Southwark Park-rd., u.t. 32½ yrs., g.r. 4*l.* 10*s.* 260
Old Kent-rd.—66 and 68, Colegrove-rd., f. 650
By BUCKLAND & SONS.
Maida Vale.—55, Lanark-villas, u.t. 50 yrs., g.r. 10*l.*, r. 52*l.* 380
By DEVERELL & HILL.
Cricklewood.—30 to 36 (even), Oak-grove, u.t. 95 yrs., g.r. 28*l.* 1,650
Hampstead.—5, Holmdale-rd., u.t. 81 yrs., g.r. 8*l.*, r. 45*l.* 500

Contractions used in these lists.—F.g.r. for freehold ground-rent; l.g.r. for leasehold ground-rent; i.g.r. for improved ground-rent; g.r. for ground-rent; r. for rent; f. for freehold; c. for copyhold; l. for leasehold; e.r. for estimated rental; u.t. for unexpired term; p.a. for per annum; yrs. for years; st. for street; rd. for road; sq. for square; pl. for place; ter. for terrace; cres. for crescent; yd. for yard.

PRICES CURRENT OF MATERIALS.

*** Our aim in this list is to give, as far as possible, the *average* prices of materials, not necessarily the lowest. Quality and quantity obviously affect prices—a fact which should be remembered by those who make use of this information.

BRICKS, &c.

	s.	d.				
Hard Stocks	35	0	per thousand alongside, in river.			
Rough Stocks and Grizzles	31	0	,,	,,	,,	,,
Smooth Bright Facing Stocks..	58	0	,,	,,	,,	,,
Shippers	42	0	,,	,,	,,	,,
Flettons.....	29	6	,,	,,	at railway depôt.	
Red Wire Cuts ..	35	0	,,	,,	,,	,,
Best Fareham Red	72	6	,,	,,	,,	,,
Best Blue Pressed Staffordshire ..	87	0	,,	,,	,,	,,
Do., Bullnose	92	0	,,	,,	,,	,,
Best Stourbridge Fire Bricks	84	6	,,	,,	,,	,,
Best White and Ivory Glazed Stretchers.....	250	0	,,	,,	,,	,,
Headers	240	0	,,	,,	,,	,,
Quoins, Bullnose, and Flats	340	0	,,	,,	,,	,,
Double Stretchers	380	0	,,	,,	,,	,,
Double Headers..	320	0	,,	,,	,,	,,
Outside and two Ends	380	0	,,	,,	,,	,,
Two Sides and one End	400	0	,,	,,	,,	,,
Splays, Chamfered, Squints	400	0	,,	,,	,,	,,
Best Dipped Salt Glazed Stretchers and Headers ..	240	0	,,	,,	,,	,,
Quoins, Bullnose, and Flats	280	0	,,	,,	,,	,,
Double Stretchers	320	0	,,	,,	,,	,,
Double Headers..	280	0	,,	,,	,,	,,
One Side and two Ends	300	0	,,	,,	,,	,,
Two Sides and one End	300	0	,,	,,	,,	,,
Splays, Chamfered, Squints	280	0	,,	,,	,,	,,
Seconds Quality White and Dipped Salt Glazed	40	0	per thousand less than best.			

[*See also page 243.*

COMPETITIONS, CONTRACTS, AND PUBLIC APPOINTMENTS.

(For some Contracts, &c., still open, but not included in this List, see previous issues.)

COMPETITIONS.

Nature of Work.	By whom Advertised.	Premiums.	Designs to be delivered
*Isolation Hospital	Sevenoaks U.D.C.	10*l.* 10*s.*	Oct. 20
*New Municipal Buildings	South Shields Corporation		Dec. 31

CONTRACTS.

Nature of Work or Materials.	By whom Required.	Forms of Tender, &c., Supplied by	Tenders to be delivered
Several Cottages, Coalburns, &c.	Consett Iron Co., Ltd.	C. E. Oliver, Architect, Consett, Durham	Sept. 17
Additions to Rhos Chapel, Mountain Ash		Morgan & Elfard, Architects, 1, Jeffrey-street, Mountain Ash	Sept. 18
School, Bordesley-green-road	Birmingham School Board	Martin & Martin, Architects, 106, Colmore-row, Birmingham	do.
Reservoir	Dursley (Glos.) R.D.C.	Taylor & Co., Engineers, 27, Great George-street, Westminster	do.
*Kerbing, Channelling, &c.	Tottenham U.D.C.	P. E. Murphy, Engineer, 712, High-road, Tottenham	do.
Police Station, Shotton, Flints		J. H. Davies & Sons, Architects, 24, Newgate-street, Chester	Sept. 19
Alterations, &c., to Three Shops, Blackfriars-road	Salford Corporation	Borough Engineer, Town Hall	do.
Home, House, Offices, &c., Chapel-Allerton	Leeds Guardians	P. Robinson, Architect, 72, Albion-street, Leeds	do.
Sewerage Works, Essex-road	Hoddesdon (Herts.) U.D.C.	T. Salkield, Surveyor, Lord-street, Hoddesdon	do.
*Heating and Ventilating of Board School, Halifax		C. F. L. Horsfall & Son, Architects, Halifax	do.
*Additions to Nurses' Home, &c., Tooting	Wandsworth and Clapham Union	Cecil A. Sharp, 11, Old Queen-street, S.W.	Sept. 20
Repairing Shops, &c., Broadley-street	Hull Corporation	F. J. Bancroft, Engineer, Town Hall	do.
School, Devonshire-road	Blackpool School Board	R. B. Mather, Architect, Abingdon-street, Blackpool	do.
Additions, &c., to Buildings, Wellington-road	Dewsbury Pioneers' Indus. Soc.	Holtom & Fox, Architects, Corporation-street, Dewsbury	do.
Power Station, St. Ann's Well-road	Nottingham Corporation	A. Brown, Civil Engineer, Guildhall, Nottingham	Sept. 21
*Police Cottage at Thakeham	West Sussex County Council	County Surveyor, 31, Bedford-road, Horsham	Sept. 22
Limestone, &c., 600 tons	Bedwellty (Mon.) U.D.C.	J. H. Lewis, Civil Engineer, Town Hall, Tredegar	do.
Offices, &c., Dipton	Annfield Plain Indus. Co-op. Soc.	G. T. Wilson, Architect, 121, Durham-road, Blackhill	do.
Stable and Coach House, Ponthirwen, Wales		J. P. Lloyd, Ponthirwen, Cardiganshire	do.
Stabling, &c.	Halifax Corporation	C. F. L. Horsfall & Son, Architects, Halifax	do.
Sewers, &c.	Durham U.D.C.	H. W. Taylor, C.E., St. Nicholas Chambers, Newcastle-on-Tyne	do.
Building Work at Gasworks	Blackburn Corporation	S. R. Ogden, Engineer, Municipal Offices	do.
*Brick Chimney Shaft	Tunbridge Wells Corporation	Borough Engineer, Town Hall, Tunbridge Wells	Sept. 24
Pipe Laying, &c.	Burnham (Somerset) U.D.C.	W. J. Press, Engineer, Town Hall	do.
Cottage Home, Upton-by-Chester	Chester Guardians	Lockwood & Sons, Architects, 80, Foregate-street, Chester	do.
Hospital, Newby-lane	Scarborough Town Council	H. W. Smith, Borough Engineer, Town Hall	do.
*Three Shops, Barnes	West Ham County Council	F. & W. Stocker, Architects, 90, Queen-street, E.C.	do.
*Quarter Sessions Court, &c.	do.	Borough Engineer, Town Hall, West Ham, E.	Sept. 25
*Fencing	do.	do.	do.
*Making-up Streets	H.M. Office of Works	do.	do.
*Post Office at W. Brompton, S.W.	Sheffield Corporation	Mr. Wager, Office of Works, Storey's Gate, S.W.	do.
*Bridge	do.	City Surveyor, Town Hall, Sheffield	do.
*Baths and Library	Willesden District Council	do.	do.
*Road Making and Paving Works	Sheffield Corporation	O. Claude Robson, Public Offices, Kilburn	do.
Public Baths, Duke-street Park	Heworth School Board	C. F. Wike, Civil Engineer, Town Hall	do.
Schools, Felling	Bradford Corporation	H. Miller, Civil Engineer, Felling	do.
Inn, Westgate	Epsom R.D.C.	J. H. Cox, Surveyor, Town Hall	do.
*Sewerage Works, Cheam	The Company	H. D. Searles Wood, 157, Wool Exchange, E.C.	do.
*New Roads, Muswell Hill	Hertfordshire County Council	Vigers & Co., 4, Frederick's-place, Old Jewry, E.C	Sept. 26
*Police Cottages at Hatfield	Greenwich Board of Works	County Surveyor, 41, Parliament-street, S.W.	do.
*Supply of Road Materials	Chiswick U.D.C.	The Clerk, 141, Greenwich-road, S.E.	do.
*Alterations and Additions to Free Public Library	Kensington Guardians	A. Ramsden, Surveyor, Sutton Court, Chiswick	do.
*Enlargement of Master's House at Workhouse	Messrs. W. & N. Blakeley	Ernest Flint, Architect, 80, Coleman-street, E.C.	Sept. 27
Four Houses and Shop, Wide-lane, Morley	Wirral R.D.C.	Buttery & Birds, Architects, Morley	do.
Making Quarry-road, Heswall	Messrs. J. Shearer & Son	T. Davies, Surveyor, Eastham, Cheshire	do.
Concrete Graving Dock, nr. Scotstoun Station, Glasgow	Tunbridge Wells Corporation	J. Deas, Civil Engineer, 53, Bothwell-street, Glasgow	do.
Technical Institute		H. J. Hare, Architect, 13, Hart-street, London, W.C.	do.
Mission Room, Millbank, Holyhead	Croydon Council	G. P. Griffith, Compton House, Holyhead	do.
Sale of Old Granite Setts	Glasgow Corporation	Borough Road Surveyor, Town Hall, Croydon	Sept. 28
Cast-iron Piping, &c., Pinkston	West Sussex County Council	J. Young, 88, Renfield-street, Glasgow	do.
*Police Station at Arundel	Shifnal Guardians	County Surveyor, 31, Bedford-road, Horsham	Sept. 29
*Infirmary	Mansfield School Board	Clerk, Guardians' Offices, Market Place, Shifnal, Salop	do.
*Schools at Pleasley Hill, near Mansfield	Erith U.D.C.	Vallance & Westwick, Archts., White Hart Chmbrs., Mansfield	Oct. 1
*Forty-eight Cottages, Belvedere, &c.	Shardlow R.D.C.	Council's Surveyor, High-street, Erith	do.
Sewers, &c., Normanton by Derby	Carmarthenshire County Council	T. A. Fuller, Surveyor, The College, All Saints, Derby	do.
Bridge Works over River Amman, Llandeble	Salford Corporation	J. Jones, County Council Office, Llandovery	do.
Refuse Destructor, Carey-street	Willesden Guardians	W. H. Hambiett, Wilburn-street Depot, Salford	Oct. 2
*New Infirmary, Acton-lane	St. Albans, St. Peter's, Vicar, &c.	A. Saxon Snell, 22, Southampton-buildings, W.C.	Oct. 3
*Alterations to Parish Hall & Erection of New Schools	Chaseside Building Estate Owners	F. W. Kinneir Tarte, 12, St. Peter-street, St. Albans	Oct. 4
*Roadmaking and Sewers, &c., Enfield	Newhaven R.D.C.	Walton & Lee, 10, Mount-street, Grosvenor-sq., W.	do.
*Laying Stoneware Pipe Sewers, &c., Rottingdean	Hertford Corporation	T. W. Franks, Engineer, Severn Buildings, Lewes	do.
Lodge, &c., at Hospital, Gallows Plain	Pembroke School Board	W. L. Grant, Architect, Town Hall	Oct. 8
Schools, Meyrick-road	Grammar School Governors	G. Morgan & Son, Architects, 24, King-street, Carmarthen	Oct. 9
School with Master's House, Lichfield		Clerk to the Governors, Bird-street, Lichfield	Oct. 13
Offices, Museum-street, Ipswich		G. W. Leighton, Architect, 6, Princes-street, Ipswich	No date
Church, &c., Ashley-road, Branksome, Dorset		Rev. A. Cleaver, Warwick Lodge, Sandecoates, Parkstone	do.
Shop, &c., Scotch Quarter, Carrickfergus		S. P. Close, Architect, Carrickfergus	do.
House, Haslemere		A. G. Hastilow, Architect, 1, Glendarvon-street, Putney	do.
Trades' Hall, Longford-street, Heywood		Openshaw & Gill, Architects, 5, Church-street, Heywood	do.
Alterations to Post Office, Ulverston		Settle & Farmer, Architects, Ulverston	do.

PUBLIC APPOINTMENTS

Nature of Appointment.	By whom Advertised.	Salary.	Application to be in
*Clerk of Works	Shoreditch Public Health Com.	3*l.* 3*s.* weekly	Sept. 17
*Clerk of Works	Marlborough Corporation	3*l.* 3*s.* weekly	Sept. 22
*Clerk of Works	Poplar Union	3*l.* 10*s.* per week	do.

Those marked with an asterisk (*) are advertised in this Number. *Competitions, p.* iv. *Contracts, pp.* iv, vi. viii. x. *&* xxi. *Public Appointments, pp.* xix. *&* xxi.

PRICES CURRENT (*Continued*).

Thames and Pit Sand	8 0	per yard, delivered.
Thames Ballast	6 9	,, ,,
Best Portland Cement	37 6	per ton ,,
Best Ground Blue Lias Lime	24 0	,, ,,

NOTE.—The cement and lime is exclusive of the ordinary charge for sacks.

Grey Stone Lime	12s. 6d. per yard, delivered.
Stourbridge Fire-clay in sacks, 32s. 6d. per ton at rly. dpt.	

STONE.

	s. d.	
Ancaster in blocks	2 0	per ft. cube, deld. rly. depôt
Bath ,,	1 7	,, ,,
Beer ,,	1 6½	,, ,,
Grinshill ,,	1 10	,, ,,
Brown Portland in blocks	2 2	,, ,,
Darley Dale ,,	2 1½	,, ,,
Red Corsehill ,,	2 5	,, ,,
Red Mansfield ,,	2 4½	,, ,,
Hard York ,,	2 10	,, ,,
Hard York 6 in. sawn both sides landings, to sizes (under 40 ft. sup.)	2 7	per ft. super. at rly. depôt.
,, ,, 6 in. Rubbed Ditto	2 10½	,, ,,
,, ,, 3 in. sawn both sides slabs (random sizes)	1 3	,, ,,
,, ,, 3 in. self-faced Ditto	0 9	,, ,,

SLATES.

in. in.	£ s. d.	
20 × 10 best blue Bangor	11 5 0	per 1000 of 1200 at ry. dep
,, best seconds ,,	10 15 0	,, ,,
16 × 8 best ,,	6 2 6	,, ,,
20 × 10 best blue Portmadoc	10 18 0	,, ,,
16 × 8 best blue Portmadoc	6 0 0	per 1000 of 1200 at ry. dep.
20 × 10 best Eureka unfading green	11 2 6	,, ,,
16 × 8 ,, ,,	6 15 0	,, ,,
20 × 10 Permanent green and Sedan green	10 0 0	,, ,,
16 × 8 ,, ,,	5 12 6	,, ,,

TILES.

	s. d.	
Best plain red roofing tiles	41 6	per 1,000 at rly. depôt.
Hip and valley tiles	3 7	per doz. ,, ,,
Best Broseley tiles	48 6	per 1,000 ,, ,,
Hip and valley tiles	4 0	per doz. ,, ,,
Best Ruabon Red, brown or brindled Do. (Edwards)	57 6	per 1,000 ,, ,,
Do. ornamental Do.	60 0	,, ,, ,,
Hip tiles	4 0	per doz. ,, ,,
Valley tiles	3 9	,, ,, ,,
Best Red or Mottled Staffordshire Do. (Peakes)	50 9	per 1,000 ,, ,,
Hip tiles	4 1	per doz. ,, ,,
Valley tiles	3 8	,, ,, ,,

WOOD.

BUILDING WOOD.—YELLOW.

	At per standard. £ s. d.	£ s. d.
Deals: best 3 in. by 11 in. and 4 in. by 9 in. and 11 in.	16 10 0	18 0 0
Deals: best 3 by 9	14 10 0	15 10 0
Battens: best 2½ in. by 7 in. and 8 in. and 3 in. by 7 in. and 8 in.	12 10 0	13 10 0
Battens: best 2½ by 6 and 3 by 6	0 10 0	less than 7 in. and 8 in.
Deals: seconds	1 0 0	less than best
Battens: seconds	0 10 0 ,, ,,	,,

	At per load of 50 ft.	
Fir timber: Best middling Danzig or Memel (average specification)	4 10 0	5 0 0
Seconds	4 5 0	4 10 0
Small timber (8 in. to 10 in.)	3 12 6	3 15 0
Swedish balks	2 15 0	3 0 0
Pitch pine timber (35 ft. average)	4 0 0	4 10 0

JOINERS' WOOD.

	At per standard.	
White Sea: First yellow deals, 3 in. by 11 in.	27 10 0	28 10 0
3 in. by 9 in.	24 0 0	25 0 0
Battens, 2½ in. and 3 in. by 7 in.	20 0 0	21 0 0
Second yellow deals, 3 in. by 11 in.	22 10 0	24 0 0
,, ,, 3 in. by 9 in.	20 0 0	21 0 0
Battens, 2½ in. and 3 in. by 7 in.	16 10 0	18 0 0
Third yellow deals, 3 in. by 11 in. and 9 in.	16 10 0	18 0 0
Battens, 2½ in. and 3 in. by 7 in.	13 10 0	14 10 0
Petersburg: first yellow deals, 3 in. by 11 in.	25 0 0	26 0 0
Do. 3 in. by 9 in.	22 0 0	23 0 0
Battens	16 10 0	17 10 0
Second yellow deals, 3 in. by 11 in.	18 10 0	20 0 0
Do. 3 in. by 9 in.	17 0 0	18 0 0
Battens	14 0 0	14 10 0
Third yellow deals, 3 in. by 11 in.	15 0 0	16 10 0
Do. 3 in. by 9 in.	14 0 0	14 10 0
Battens	12 10 0	13 10 0
White Sea and Petersburg:—		
First white deals, 3 in. by 11 in.	15 10 0	16 10 0
,, ,, 3 in. by 9 in.	14 0 0	15 0 0
Battens	12 10 0	13 10 0
Second white deals 3 in. by 11 in.	14 0 0	15 0 0
,, ,, ,, 3 in. by 9 in.	13 0 0	14 0 0
,, ,, battens	11 0 0	12 0 0
Pitch pine: deals	16 0 0	18 0 0
Under 2 in. thick extra	0 10 0	1 0 0
Yellow Pine—		
First, regular sizes	30 0 0	33 0 0
Broads (12 in. and up)	2 0 0	more.
Oddments	22 0 0	24 0 0
Seconds, regular sizes	24 10 0	26 10 0
Oddments	20 0 0	22 0 0
Kauri Pine—		
Planks, per ft. cube	3 6	0 4 6

PRICES CURRENT (*Continued*).

	At per standard. £ s. d.	£ s. d.
Dantzig and Stettin Oak Logs—		
Large, per ft. cube	0 2 6	0 2 8
Small ,, ,,	0 2 4	0 2 7
Wainscot Oak Logs, per ft. cube	0 5 0	0 5 6
Dry Wainscot Oak, per ft. sup. as inch	0 0 8	0 0 9
¾ in. do. do.	0 0 7	- - -
Dry Mahogany—		
Honduras, Tabasco, per ft. sup. as inch	0 0 9	0 0 11
Selected, Figury, per ft. sup. as inch	0 1 6	0 2 0
Dry Walnut, American, per ft. sup. as inch	0 0 10	0 1 0
Teak, per load	16 0 0	20 0 0
American Whitewood Planks—		
Per ft. cube	0 2 3	0 3 0

JOISTS, GIRDERS, &c.

	In London, or delivered to Railway Vans, per ton. £ s. d.	£ s. d.
Rolled Steel Joists, ordinary sections	9 7 6	- - -
Compound Girders ,, ,,	13 10 0	- - -
Angles, Tees and Channels, ordinary sections	12 10 0	14 10 0
Flitch Plates	12 0 0	- - -

METALS.

	Per ton, in London. £ s. d.	£ s. d.
IRON.—		
Common Bars	10 0 0	10 10 0
Staffordshire Crown Bars, good merchant quality	11 5 0	11 15 0
Staffordshire "Marked Bars"	13 5 0	- - -
Hoop Iron, basis price	11 5 0	11 15 0
,, ,, galvanised	17 0 0*	- - -
(* And upwards, according to size and gauge.)		
Sheet Iron, Black.—		
Ordinary sizes to 20 g.	11 10 0	- - -
,, ,, to 24 g.	12 15 0	- - -
,, ,, to 26 g.	13 15 0	- - -
Sheet Iron, Galvanised, flat, ordinary quality.—		
Ordinary sizes, 6 ft. by 2 ft. to 3 ft. to 20 g.	14 15 0	- - -
,, ,, 22 g. and 24 g.	15 5 0	- - -
,, ,, 26 g.	16 15 0	- - -
Sheet Iron, galvanised, flat, best quality.—		
Ordinary sizes to 20 g.	18 10 0	- - -
,, ,, 22 g. and 24 g.	19 0 0	- - -
,, ,, 26 g.	20 10 0	- - -
Galvanised Corrugated Sheets.—		
Ordinary sizes, 6 ft. to 8 ft. 20 g.	14 0 0	14 15 0
,, ,, 20 g. and 24 g.	14 15 0	15 10 0
Cut nails, 3 in. to 6 in. (Under 3 in. usual trade extras.)	11 10 0	- - -
LEAD—Sheet, English, 3 lbs. & up.	20 7 6	- - -
Pipe in coils	20 17 6	- - -
ZINC—Sheet—		
Vieille Montagne ton	28 0 0	- - -
Silesian	27 10 0	- - -
COPPER—		
Strong Sheet per lb.	0 1 1	- - -
Thin ,,	0 1 3	- - -
Copper nails ,,	0 1 3½	- - -
BRASS—		
Strong Sheet ,,	0 0 11	- - -
Thin ,,	0 1 1	- - -
TIN—English Ingots ,,	0 1 7	- - -
SOLDER—Plumbers' ,,	0 0 8	- - -
Tinmen's ,,	0 0 10	- - -
Blowpipe ,,	0 1 0	- - -

ENGLISH SHEET GLASS IN CRATES.

15 oz. thirds	2½d. per ft. delivered.
,, fourths	2¾d. ,, ,,
21 oz. thirds	3¼d. ,, ,,
,, ,, fourths	3d. ,, ,,
26 oz. thirds	4¼d. ,, ,,
,, ,, fourths	4d. ,, ,,
32 oz. thirds	5¼d. ,, ,,
,, ,, fourths	5d. ,, ,,
Fluted sheet, 15 oz.	3¼d. ,, ,,
,, ,, 21 ,,	4¼d. ,, ,,
½ Hartley's Rolled Plate	3d. ,, ,,
⅜ ,, ,, ,,	3½d. ,, ,,
¼ ,, ,, ,,	4d. ,, ,,

OILS, &c.

	£ s. d.
Raw Linseed Oil in pipes per gallon	0 3 1
,, ,, ,, in barrels ,,	0 3 2
,, ,, ,, in drums ,,	0 3 4
Boiled ,, ,, in pipes ,,	0 3 4
,, ,, ,, in barrels ,,	0 3 5
,, ,, ,, in drums ,,	0 3 7
Turpentine, in barrels ,,	0 2 5
,, in drums ,,	0 2 7
Genuine Ground English White Lead ...per ton	27 10 0
Red Lead, Dry ,,	25 0 0
Best Linseed Oil Putty ...per cwt.	0 9 6
Stockholm Tar ... per barrel	1 7 0

VARNISHES, &c.

	per gallon. £ s. d.
Fine Elastic Copal Varnish or outside work	0 16 6
Best Elastic Copal Varnish for outside work	1 0 0
Best Elastic Carriage Varnish for outside work	0 16 6
Best Hard Oak Varnish for inside work	0 10 6
Best Extra Hard Church Oak Varnish for inside work	0 10 6
Fine Hard Copal Varnish for inside work	0 16 0
Best Hard Copal Varnish for inside work	1 0 0
Best Hard Carriage Varnish for inside work	0 16 0
Extra Pale Paper Varnish	0 12 0
Best Japan Gold Size	0 10 0
Best Black Japan	0 16 0
Oak and Mahogany Stain	0 9 0
Brunswick Black	0 9 0
Berlin Black	0 15 6
Knotting	0 10 0
Best French and Brush Polish	0 10 0

TO CORRESPONDENTS.

W. P.—J. C.—J. W. R. (Amounts should have been stated). W. G. S. & Co. (Below our limit). S. V. & D. Co. (Shall have attention).

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TENDERS.

[Communications for insertion under this heading should be addressed to "The Editor," and must reach us *not later than 10 a.m. on Thursdays*. N.B.—We cannot publish tenders unless authenticated either by the architect or the building-owner; and we cannot publish announcements of tenders accepted unless the amount of the tender is given, nor any list in which the lowest tender is under £100, unless in some exceptional cases and for special reasons.]

* Denotes *accepted*. † Denotes *provisionally accepted*.

BODMIN.—For the construction of cattle market and fair park, Westheath, for the Urban District Council of Bodmin. Plans and Specifications prepared by Mr. E. J. Oliver, Borough Surveyor:—

J. Hancock	£1,938	Brown & Son	£1,600
Shelley & Sons	1,703	E. Harris*	1,532
F. Ham	1,700		

[All of Bodmin.]

BOURNEMOUTH.—For alterations, for new branch of London and South-Western Bank, Bournemouth. Mr. J. F. Fogerty, architect, 2, St. Peter's-terrace, Bournemouth:—

Wm. Hoare	£2,254 0	George & Harding	£1,900 0
Jones & Son	2,128 0	Jenkins & Sons*	1,988 0
Miller & Sons	2,030 15		

BRANDON (Co. Durham).—For new stores and hall, Meadowfield, for the Co-operative Society. Mr. Wm. Perkins, architect, Bishop Auckland:—

T. & J. White, Newcastle-on-Tyne* ... £12,300

BRIGHTLINGSEA (Essex).—For making-up Nelson road and several others for the Urban District Council:—

Dupont & Co.	£2,859	W. Manders	£2,534
Moran & Son	2,742	Mackenzie & Son, Clacton-on-Sea*	2,492
Burgoyne & Son	2,703		

BRIGHTON.—For the erection of a house, two cottages, walls, &c., Mile Oak pumping station, near Portslade, for the Corporation of Brighton. Mr. J. Johnston, waterworks engineer:—

C. Y Smith	£3,920 0 0	S. Pearce	£2,748 0 0
Longley & Co.	3,886 0 0	Cook & Sons, Crawley*	2,515 0 0
A. E. Nunn	3,069 8 6		

BRIGHTON.—For the construction of a concrete groyne, Lewes-crescent, for the Town Council. Mr. F. J. C. May, C.E., Town Hall, Brighton:—

J. & F. Binns	£6,742 12 6	Cooke & Co., London*	£4,500 0 0
Fasey & Son	5,286 9 8		

DEVONPORT.—For the erection of workmen's dwellings, James-street, for the Town Council. Mr. John F. Burns, Borough Engineer, 30, Ker-street, Devonport:—

H. E. Skinner	£7,707 11 6	Lethbridge & Son	£6,477 0 0
Thos. May	6,769 15 0	A. N. Coles	6,400 0 0
Wakeham Bros.	6,665 0 0	W. E. Blake*	6,362 0 0
S. Roberts	6,542 10 6		

[All of Plymouth.]

DURHAM.—For the conversion of outbuildings into cottages, Sands House, Durham. Mr. H. T. Gradon, architect, Durham:—

A. Fry	£948 0 0	G. T. Manners	£809 0 0
Wm. Lodge	900 0 0	Wm. Pratt	770 17 4

DURHAM.—For rebuilding premises, No. 29, Silver street, Durham. Mr. H. T. Gradon, architect, Durham:—

Draper & Sons	£2,532 5 10	J. Shepherd	£1,868 0 0
G. T. Manners	2,085 0 0	Gradon & Son	1,715 0 0

DURHAM.—For two houses, Nos. 4 and 5, Fieldhouse-terrace, Durham. Mr. H. T. Gradon, architect, Durham:—

Wm. Lodge	£1,750 15	Gradon & Son	£1,520 0
J. Shepherd	1,699 0	C. W. Gibson	1,500 0
G. T. Manners	1,645 0	Draper & Son	1,450 0
T. Coates	1,535 0		

EGREMONT (Cumberland).—For alterations, &c. to shop and warehouse for the Egremont Industrial Co-operative Society. Messrs. W. G. Scott & Co., architects, Victoria-buildings, Workington:—

Building.—H. Eilbick, Egremont	£228 7 1
Joinery.—G. H. Chambers, Workington	133 0 0
Slating.—J. Wilson, Egremont	110 10 0
Plastering.—J. Wilson, Egremont	
Plumbing.—W. Strathem, Whitehaven	69 0 0
Painting and Glazing.—Armstrong & Reid, Workington	37 0 0

[*See also next page.*

FALKIRK.—For the erection of school buildings, Camelon, for the Falkirk Parish School Board. Mr. James Strang, architect, Vicar-street, Falkirk. Quantities by Mr. Robert Sandilands, 154, West Regent-street, Glasgow :—

Masonry.—George Sanderson, Falkirk ..
Joinery.—Wm. Walker, Polmont Station
Slating.—Drummond Crowe, Laurieston.
Plumbing and Gasfitting.—Wallace & Connell, Falkirk.. ..... } £9,334
Plastering.—Jas. Miller, Falkirk .....
Tiling.—Haig Bros., Glasgow .....
Glazing.—Dan. O'May, Falkirk .....
Heating.—Combe & Son, Glasgow .....
Iron Railings and Gates.—John Kidd, Camelon .....
Painting.—Thos. McKenzie, Falkirk.....

FENNY STRATFORD.—For the erection of school buildings, for the School Board. Mr. John Chadwick, architect, Fenny Stratford :—

Wm. Wade	£4,788	Walter & Austin...	£4,413
Thos. Yirrill	4,697	A. Taylor, Fenny Stratford*	4,360
H. Coleman.....	4,585		
Alf. Atkins	4,497		

GARFORTH (Leeds).—For alterations, &c., to shop. Mr. W. Wrigley, architect, 6, Westgate, Wakefield :—
Tom Blakey, Leeds.....£115

HULL.—For additions, &c., to school, Wawne-street, for the Kingston-upon-Hull School Board. Mr. B. S. Jacobs, architect, Lincoln's Inn Buildings, Bowlalley-lane, Hull :—

Blackburn & Son....	£5,685	W. Hodgson	£5,310
J. Houlton	5,598	Jackson & Sons	5,319
V. Knowles	5,580	Hockney & Liggins	5,298
G. Houlton	5,540	C. Greenwood	5,118
W. Sanderson	5,420	M. Harper*	5,087
T. Goates	5,354		

[All of Hull.]

LINLITHGOW.—For the erection of an academy, for the School Board. Mr. J. Graham Fairley, architect, 1, India-buildings, Edinburgh. Quantities by architect :—

Masonry.—R. & W. Philip, Linlithgow*	£2,799	8	8
Joinery.—William Walker, Pelmont*	1,402	13	4½
Slating.—D.& A.Grant, Linlithgow*	361	12	11½
Plastering.—D. Macnair, Falkirk*	175	9	1
Plumbing.—Blake & Co., Edinburgh*	390	10	0
Painting.—M. Mackinzie, Linlithgow*	49	6	2
Heating.—Cameron & Co., Govan*	211	15	9
Total	5,390	18	0

LONDON.—For the erection of a refuge dwelling, Reeve's-place, Hoxton, for the Shoreditch Vestry. Mr. J. Rush Dixon, C.E., Town Hall, Old-street, E.C. :—

Ridgway & Sons	£2,550	12	J. Ivory, Great Cambridge-st., N.E.* £1,368 10
Wells & Co.....	2,190	0	
Elkington & Son	2,012	15	
J. Weibking	1,645	0	

LONDON.—For steam-engine and steam laundry machinery at the Fever Hospital extension, Plaistow, for the Works Department of the Corporation of West Ham. Mr. Edwin T. Hall, architect, 57, Moorgate-street, E.C. :—
The Manchester Laundry Engineering Co.* £1,053

MAESTEG (Wales).—For the erection of a hospital, with administrative block, &c. for the Hospital Committee. Mr. J. Humphreys, C.E., Town Hall-chambers, Maesteg :—
Isaac Rees £4,486 0 0
Lewis Williams, 12, Queen-street, Maesteg* 3,625 0 0

TYLORSTOWN (Glamorgan).—For additions to Horeb Baptist Chapel, Tylorstown, for the Building Committee. Messrs. Griffiths & Jones, Tonypandy and Llandaff, architects :—
W. D. Humphreys, Pembroke House, Tylorstown, Glamorgan* £875

WEST DEEPING (Lincs).—For the erection of schoolteacher's residence, for the managers of the West Deeping Voluntary School. Mr. J. C. Traylen, architect, 15, Broad-street, Stamford. Quantities by the architect :—

Letall	£436	8	Cave £376 0
Hawkins.....	425	0	Chappell 375 0
Pine & Son	413	5	R. Plowright, Langtoft Market, Deeping* 298 0
Furnis Bros.	413	0	
Gelsthorpe & Son..	381	0	

WOKING.—For alterations to No. 1, The Pavement, to convert same into banking premises, for the London and South-Western Bank, Limited. Mr. William G. Jones, architect, Woking. Quantities by Mr. John Scott, surveyor, 23, Bedford-row, London, W.C. :—

Oldridge & Sons	£2,980	0	Gaze & Son..... £2,739 0
A. A. Gale	2,928	0	Wheatley 2,690 0
J. Whitburn	2,828	0	Drowley & Co... 2,657 18
Greenfield	2,770	0	Harris & Son, Woking* 2,595 0
Potterton	2,750	0	

WORKINGTON.—For the erection of a drill-hall, Edkin-treet, for Artillery Volunteers. Messrs. W. G. Scott & Co., architects, Victoria-buildings, Workington. Quantities by architects :—

Building.—G. Mann.....	£913	0	0
Joinery.—J. Steel	631	1	6
Plumbing.—J. A. Pape.....	145	10	0
Plastering.—J. Lawson	102	10	0
Slating.—J. Lythgoe.....	97	4	0
Glazing and Painting.—T. D. Keenlinde	82	10	5

[All of Workington.]

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